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# SCOUT ERROR ANALYSIS PHASE II FINAL REPORT

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Prepared under Contract No. NAS1-6969
for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

[redacted]

TRW
SYSTEMS GROUP OF TRW INC.

NASA CR-66674

# SCOUT ERROR ANALYSIS PHASE II FINAL REPORT

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Prepared under Contract No. NAS1-6969
TRW Systems Group
Redondo Beach, California

for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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## SUMMARY

This report is presented in fulfillment of the statement of work of contract No. NAS1-6969 for Phase II as amended on May 13, 1968. The statement of work required that TRW analyze the effects of Scout error sources, both individually and collectively, on the final trajectory conditions of the following two missions:

(1) Reentry mission.

(2) Five stage escape mission with both fourth and fifth stages spin stabilized.

TRW was to use the same methods and error sources developed under Phase I of the subject contract, with the Government supplying fifth stage data and error sources for the escape mission and new pitch profiles for both flights.

The results of analyzing the reentry mission produced the following one sigma errors at the time of nominal 400,000 feet altitude:

| | nominal conditions | mean dispersion | standard deviation |
|---|---|---|---|
| Velocity | 26202 ft/sec | -15.29 ft/sec | 87.0 ft/sec |
| Flight Path Angle | -3.06 deg | .0736 deg | .553 deg |
| Inclination | 50.425 deg | .047 deg | .432 deg |

The analysis of the five stage escape mission resulted in the following dispersions at fifth stage burnout:

| | nominal conditions | mean dispersion | standard deviation |
|---|---|---|---|
| Velocity | 39199.7 ft/sec | 2.02 ft/sec | 78.7 ft/sec |
| Altitude | 107.56 nmi | .424 nmi | 5.03 nmi |
| Flight Path Angle | 11.769 deg | -.007 deg | .377 deg |
| Inclination | 37.667 deg | .0168 deg | .0455 deg |


## INTRODUCTION

This report is presented in fulfillment of Phase II of contract No. NAS1-6969 as amended on May 13, 1968. The statement of work called for the analysis of two missions:

(1) A four stage trajectory designed to reenter the Earth's atmosphere. TRW was instructed to determine the expected dispersions in the trajectory at an altitude of 400,000 feet.

(2) A five stage mission with the fifth stage spin stabilized designed to enter interplanetary space. The data for the fifth stage was supplied by the Scout Program Office at Langley Research Center.

The error source magnitudes and the method of analysis were to be the same as developed and utilized in Phase I of the subject contract. A brief description of these methods follows but the interested reader is referred to the Phase I final report (Reference 1) for a more detailed description of the scout vehicle.

The Scout simulation equations were assumed to be a quadratic form using coefficients previously calculated in the TRW N-Stage Trajectory Program (MVNS). There were three component parts:

Linear Errors:

$$\underline{X}_L = \sum_{\substack{i=1 \\ \text{linear}}}^{95} \underline{C}_i \Delta_i \tag{1}$$

where $\underline{X}_L$ is the state vector at a stage time

$\underline{C}_i$ is the vector of linear sensitivity coefficients associated with the $i^{th}$ error source

$\Delta_i$ is a random number with standard deviation equal to $\sigma_i$

Non-linear Errors:

$$\underline{X}_{NL} = \sum_{j=1}^{8} \underline{f}_j(\Delta_j) \tag{2}$$

where $\underline{X}_{NL}$ is the non-linear state vector

$\underline{f}_j(\Delta_j)$ is the piece-wise linear function for the non-linear source j, formed by its effect at $\pm 1\sigma$, $\pm 2\sigma$, $\pm 3\sigma$.

Cross-term Errors:

$$\underline{X}_{CT} = \sum_{k=1}^{11} \sum_{\ell=k+1}^{12} \underline{C}_{k\ell} \Delta_k \Delta_\ell \tag{3}$$

where $\underline{X}_{CT}$ is the cross-term vector

$\underline{C}_{k\ell}$ is the cross-term sensitivity

finally:

$$\underline{X} = \underline{X}_L + \underline{X}_{NL} + \underline{X}_{CT} \tag{4}$$

The procedure is divided into three consecutive steps: (1) the generation of sensitivity coefficients of the state vector at the stage ignition times and at burnout or reentry with respect to error sources deviations; (2) the generation of cumulative distribution functions of desired orbital and reentry parameters using the sensitivity coefficients and the statistic of the error sources; (3) the analysis of these distribution functions. In Figure 1, a block diagram describes the relationship between the TRW programs which was used in the analysis. Each step will be discussed separately in some detail.

## Sensitivity Coefficient Generation

The state of any system, as a function of time, may be considered as a function of initial state as well as a number of performance parameters (thrust, commanded turning rates, aerodynamic properties, etc.). The effects caused by nominal values of these parameters serve to define a nominal state at some time of interest, $t_k$, i.e.,

$$X_N (t_k) = f (X_o, P, t_o; t_k) \qquad (5)$$

However, if these parameters are allowed to depart from their nominal values, a perturbed state vector is generated:

$$X (t_k) = f (X_o, P + \delta P, t_o; t_k) \qquad (6)$$

If the difference in the two state vectors is expanded into a Taylor series about the nominal value:

$$\delta X_i = \sum_{j=1}^{q} C_{ij} \, \delta P_j + \frac{1}{2} \sum_{\substack{k=1 \\ j=1}}^{q} C_{ijk}^{(2)} \, \delta P_j \, \delta P_k + \dots \qquad i = 1, 2, \dots 6 \qquad (7)$$

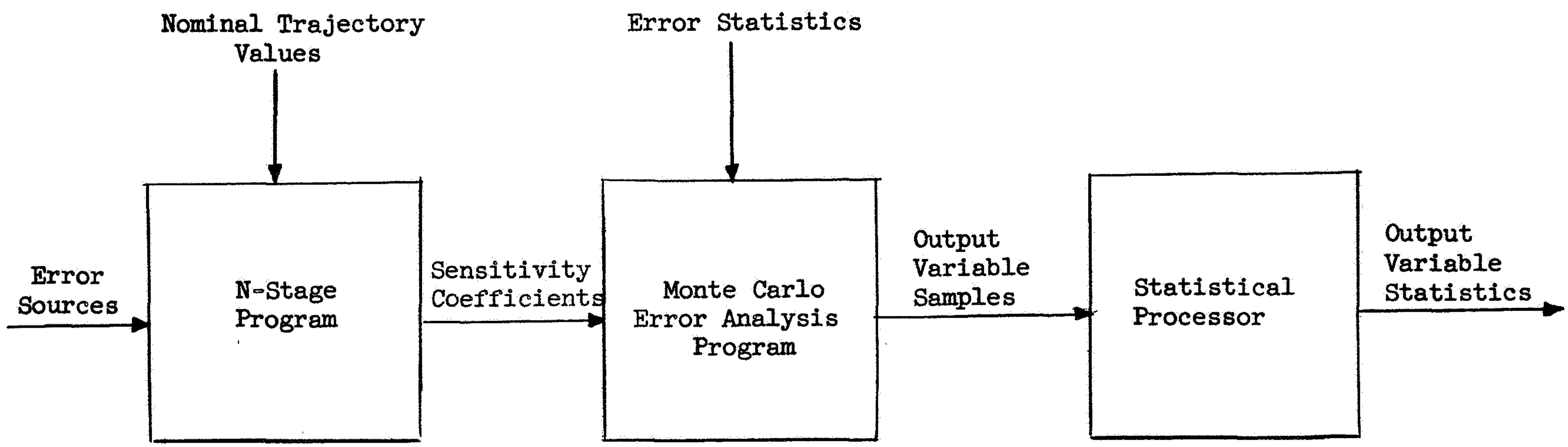


Figure 1. Programs Used in the Scout Error Analysis Program.

where:

$\delta X_i$ = the $i^{th}$ component of the difference between perturbed and nominal state vectors

$q$ is the dimension of the performance variation vector

$C_{ij}$ is the partial derivative $\partial X_i/\partial P_j$

$C_{ijk}^{(2)}$ is the second partial derivative $\partial^2 X_i/\partial P_j P_k$

The number of terms in the expansion is sufficient to adequately represent the functional dependence of the state variation with respect to these parameters. If this expansion is truncated to include only second order terms, there are q first order parameters and $\frac{q(q+1)}{2}$ second order coefficients. This would necessitate $\frac{q(q+3)}{2}$ computer runs which for the values of q modelled for the Scout analysis (~100) is unrealistic.

However, it is certainly true that certain error sources will contribute more to the state vector dispersion than others and only these major contributors need be investigated for nonlinear effects. Thus, if the linear effect of an error source on the dependent variables was found to be negligible in relation to that of more significant error sources, no attempt was made to investigate such minor sources in any greater detail. This procedure has been found by TRW Systems to be most efficient, since the time spent in modeling any error sources is roughly proportional to its overall contribution to the output. The procedure for generation of sensitivity coefficients was as follows:

1. Using the MVNS simulation of the nominal mission, perturb the system with a +3 sigma variation for each error source. Take the square root of the sum of the squares of the deviations and compare each deviation with the RSS total. If the individual deviation is less than 0.3 of the RSS total, the effect of the error source will be represented by a linear sensitivity function. This criterion guarantees that the error source deviation, when squared has a contribution of magnitude less than the total sum of the squares.

2. The selected sources were perturbed by $\pm 1\sigma$ and $\pm 2\sigma$ and $\pm 3\sigma$ to determine their degree of nonlinearity. Both postive and negative perturbations are required, since it is possible for the curve to be symmetrical while still nonlinear. If it were found that the sensitivity curve had a nonlinear shape, a straightline approximation was used to represent the partial as shown in Figure 2.

3. The next relationship to be found was the cross-correlations between these most significant variables. The difficulty of this problem is increased by the fact that the important combinations are not all known a priori. TRW Systems isolated and identified several combinations for the Phase I reference mission, so that it was not necessary to use the corresponding large amounts of machine time for each subsequent mission.

The non-linear sources investigated in this analysis were thrust misalignments and coning rate errors, since not only were these sources large contributors to the combined errors, but it is clear that major effects such as velocity loss will be the same whether the misalignment is positive or negative. Conversely, a large effect such as specific impulse tends to be linear, more impulse produces more velocity and vice-versa. In addition, this type of error source has no out of plane or in plane directional effects. To summarize, the nonlinear sources used in the analysis of the reentry mission were:

Thrust misalignments, first stage (TMP1)
Thrust misalignments, first stage (TMY1)
Thrust misalignments, second stage (TMP2)
Thrust misalignments, second stage (TMY2)
Thrust misalignments, third stage (TMP3)
Thrust misalignments, third stage (TMY3)
Coning impulse, fourth stage (WC4P)
Coning impulse, fourth stage (WC4Y)

In the escape mission the following two sources were added to the list: coning impulse, fifth stage (WC5P), coning impulse, fifth stage (WC5Y)

The cross correlations used in the Scout analysis were those combining thrust misalignments at second and third stages with their respective control system errors. These combinations are necessary to discover any of the effects

of control system errors since if they are operating on a trajectory with no upsetting moments as second and third stage are, there will be no reason for any control system activity and the nominal burnout values will be reproduced. Therefore it was necessary to provide a large and relatively constant upsetting force which led logically to the choice of thrust misalignments. The pairings which were used in both missions were:

Second Stage:

| | |
|---|---|
| Thrust Misalignment, Pitch: | Rate Gain, Pitch |
| Thrust Misalignment, Pitch: | Dead Band, Pitch |
| Thrust Misalignment, Pitch: | Roll Offset |
| Thrust Misalignment, Yaw: | Rate Gain, Yaw |
| Thrust Misalignment, Yaw: | Dead Band, Yaw |
| Thrust Misalignment, Yaw: | Roll Offset |

Third Stage:

| | |
|---|---|
| Thrust Misalignment, Pitch: | Rate Gain, Pitch |
| Thrust Misalignment, Pitch: | Dead Band, Pitch |
| Thrust Misalignment, Pitch: | Roll Offset |
| Thrust Misalignment, Yaw: | Rate Gain, Yaw |
| Thrust Misalignment, Yaw: | Dead Band, Yaw |
| Thrust Misalignment, Yaw: | Roll Offset |

It can be assumed that an output variable is related to two independent variables by the relation

$$\delta w = f(\delta x, \delta y) = C_x \delta x + C_y \delta y + C_{xx} \delta x^2 + C_{yy} \delta y^2 + C_{xy} \delta x \delta y \tag{8}$$

$$\delta w = \underbrace{C_x \delta x + C_{xx} \delta x^2}_{f_1(x)} + \underbrace{C_y \delta y + C_{yy} \delta y^2}_{f_2(y)} + C_{xy} \delta x \delta y \tag{9}$$

$$C_{xy} = \frac{\delta w - f_1(x) - f_2(y)}{\delta x \delta y} \tag{10}$$

In this equation $f_1(x)$ and $f_2(y)$ are represented by the piecewise linear functions described in the previous paragraph.

The effect of carrying out the three-step procedure outlined above has to reduce the nonlinear process (i.e., the system and its environment) to a polynomial approximation. This procedure reduced machine running time per sample from 2 to 3 minutes on the TRW Systems N-Stage program to 2 seconds on the Monte Carlo Error Analysis Program, while still including all significant non-linearities.

This polynomial fit was used to relate the input quantities to the state vector at burnout, and any unpowered propagations to other points on the trajectory were calculated by an analytical ephemeris generator.

## Monte Carlo Analysis

Using the nomenclature of the previous section, let us assume that there are q error sources, of which p are found to have either nonlinear, cross-coupling terms or both. Since the nonlinear terms have $\pm 1\sigma$, $\pm 2\sigma$ and $\pm 3\sigma$ deviations, each nonlinear error source will have a 6x6 matrix of sensitivity coefficients, i.e., the value of the output state vector as a function of $\pm n_\sigma$. These values will be used to construct a piece-wise linear function as seen in Figure 3 and replace the square terms $C^{(2)}_{ijk}\ \delta P_j^2$ in Eq. 7. The advantage of this approach is that it is not necessary to fit an arbitrarily truncated power series when the curve may contain higher components.

For each cross coupling pair of error sources, there will be a single coefficient for each output state vector component or a 6x1 vector for the output state vector. The error sources which have only linear terms can all be compressed into a single equivalent variable by the following steps. Given that:

$$X = [C]\ P \tag{11}$$

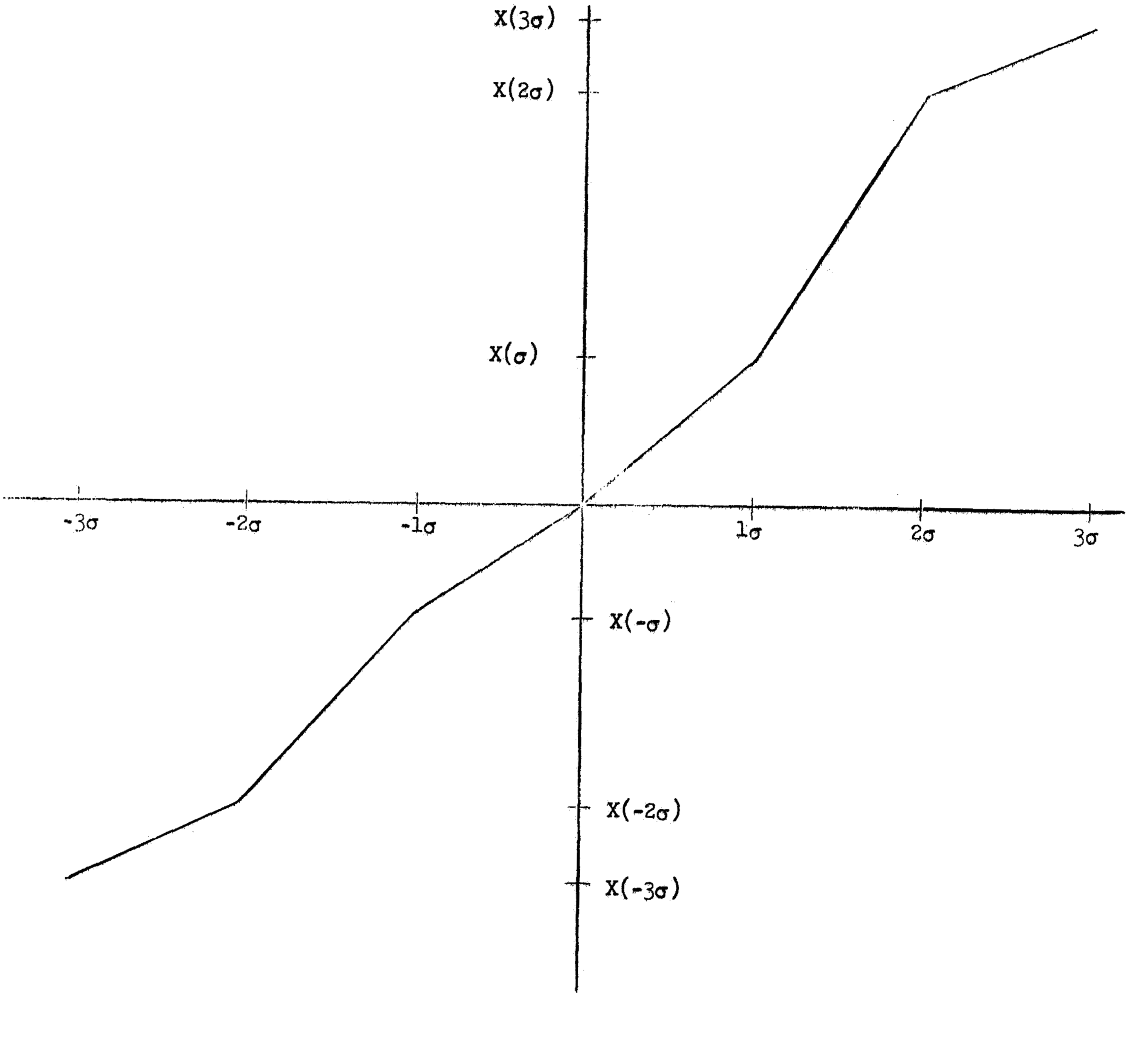


Figure 2. Piecewise Nonlinear Function

where

X is the output 6x1 state vector,

P is the linear error source vector of dimension q-p,

C is the 6 x (q-p) matrix of sensitivity coefficients,

then. $XX^T = CPP^TC^T$.

Taking the expectation of each side gives

$$\Sigma_x = C \, \Sigma_P \, C^T \tag{12}$$

where

$\Sigma_x$ is the covariance matrix of the output state vector due to linear error sources;

$\Sigma_P$ is the covariance matrix of the linear error sources.

Thus, all the linear error sources and their statistics can be compressed into a single 6x6 covariance matrix.

The Monte Carlo analysis progresses through the following steps:

(1) Using the equivalent linear covariance matrix and a random vector generator, choose a random output vector from this covariance matrix $\Sigma_x$.

(2) Using the statistics of each nonlinear source, choose a random value of this error source. Enter the piecewise linear function associated with the source and calculate the value of the output state vector dispersion due to this nonlinear effect.

(3) Using the statistics of each pair of cross coupling error sources choose pair random values. Multiply the product of these values by the cross coupling sensitivity coefficient vector to calculate the dispersion due to the combined effects of these sources.

(4) Add the three dispersions due to linear, nonlinear and cross coupling effects to the nominal state vector at burnout to calculate one sample of the analysis. Using this perturbed vector calculate the variables of interest. For the Scout analysis, the following variables were calculated and compared with their nominal values:

a. Geocentric Radius Vector

b. Inertial Velocity

c. Inertial Flight Path Angle
d. Relative Velocity
e. Flight Path Angle w/r to the Air Mass
f. Semi-major Axis
g. Eccentricity
h. Inclination
i. Longitude of the Ascending Node
j. Argument of Perigee
k. Downrange Distance from Launch Site
l. Apogee Altitude
m. Perigee Altitude
n. Period
o. Longitude
p. Latitude
q. Altitude

Statistical Analysis of Samples

The analysis of the sample statistics is relatively straightforward. The samples of any variable are used to calculate a mean and second central moment. The samples are then ordered by size and a cumulative distribution is plotted. This curve shows the correct percentile levels for the variable even though the distribution may be highly non-Gaussian.

The equations which are used in the Statistical Processor program (PROC) will be presented here. The same equations apply to both scalars and vectors unless a distinction is made in the description of the sample statistic. All computations are performed in double precision.

AVERAGE OR MEAN VALUE

The sample mean of a random vector X, denoted by X, is computed by PROC using the following equation:

$$\bar{X} = \frac{1}{N} \sum_{i=1}^{N} X_i$$

In this and all following equations, N is the total number of samples used in the computation and $X_i$ is the value of the random vector X for the $i^{th}$ sample of the Monte Carlo simulation.

## COVARIANCE MATRIX AND CORRELATION MATRIX

The covariance matrix of a random vector X, denoted by $\Sigma_{XX}$, is defined by the following equation in which E indicates the expectation operator.

$$\Sigma_{XX} = E(X - \bar{X})(X - \bar{X})^T$$

This equation can be expanded and rewritten as follows:

$$\Sigma_{XX} = E(XX^T) - (\bar{X})(\bar{X})^T$$

The equation used by PROC to compute a sample covariance matrix is similar and can be written

$$\Sigma_{XX} = \frac{1}{N-1}\left[\sum_{i=1}^{N} X_i X_i^T - \frac{1}{N}\left(\sum_{i=1}^{N} X_i\right)\left(\sum_{i=1}^{N} X_i\right)^T\right]$$

## CUMULATIVE DISTRIBUTION FUNCTION

A cumulative distribution function (CDF) is the probability that a random variable, X, is less than a specified number. This information is displayed by PROC as a graph of the probability that the random variable is less than the specified number versus the specified number. This is accomplished by ordering all of the samples in the order of increasing numerical value and plotting the percentage of the samples that are less than a given value, say $\nu$, as a function of $\nu$.

In Table 1 are listed all the error sources and their magnitudes as they were listed in Reference 1. The items in part I of the table were not the subject of any investigation in Phase I of the contract. Those in part II were the results of an investigation of log book and test data performed by TRW and described in detail in Reference 1. The fifth stage error used in the escape mission were supplied by the Scout Office in a letter.

TABLE 1. ERROR SOURCE LIST

I. Errors From Previous Investigations

| Description | Symbol | 1σ Mag. Mag. * |
|---|---|---|
| IA First Stage Errors | | |
| 1. Propellant Weight Uncertainty | PW10 | .0006 |
| 2. First Stage Inert Weight | SIW1 | .0083 |
| 3. Second Stage Inert Weight | SIW2 | .0041 |
| 4. Third Stage Inert Weight | SIW3 | .00093 |
| 5. Fourth Stage Inert Weight | SIW3 | .0024 |
| 6. Specific Impulse | ISP1 | .0018 |
| 7. Mass Flow Rate | MFR1 | .014 |
| 8. Thrust Misalignment - Pitch | TMP1 | 1.67 mrad |
| 9. Thurst Misalignment - Yaw | TMY1 | 1.67 mrad |
| 10. Drag Coefficient (CAO) | CAO1 | .01 |
| 11. Normal Force Coefficients ($CN\alpha$) | CNAL | .2 |
| 12. Normal Force Coefficients ($CN\delta q$) | CNDQ | .2 |
| 13. Side Force Coefficients ($Cy\beta$) | CYBA | .33 |
| 14. Side Force Coefficients ($Cy\delta r$) | CYDR | .33 |
| 15. Roll Moment Coefficients ($C\ell\delta p$) | CLDP | .1 |
| 16. Roll Moment Coefficients ($C\ell p$) | CLP1 | .1 |
| 17. Pitch Moment Coefficients (Cmo | CMO1 | .05** |
| 18. Pitch Moment Damping Coefficients ($Cm\delta q$) | CMDQ | .002 |
| 19. Pitch Moment Coefficients (Cmq) | CMQ1 | .002 |
| 20. Pitch Moment Coefficients ($Cm\alpha$) | CMAL | .05 |
| 21. Yaw Moment Coefficients ($Cn\beta$) | CNBA | .33 |
| 22. Yaw Moment Coefficients ($Cn\delta r$) | CNDR | .33 |
| 23. Yaw Moment Damping Coefficients (Cnr) | CNR1 | .33 |
| 24. Density Variation | DRHO | .0667 |
| 25. Wind Profile | FWN1 | - |
| 26. Jet Vane Drag Coefficient | CDV1 | .1 |
| 27. Jet Vane Drag Coefficient | CDV2 | .1 |
| 28. Jet Vane Drag Coefficient | CDV3 | .1 |
| 29. Jet Vane Side Force Coefficient | LDA2 | .1 |

* Where no units appear, the magnitude is a fraction of nominal.

** This error source magnitude was inadvertently input to both analyses as .002. The effect of the error source was so small, however, that it could not effect the results even if the 1σ value were increased 25 times.

| Description | Symbol | 1σ Mag. Mag. |
|---|---|---|
| 30. Roll Moment due to Yaw Axis Shift of Static Margin | LSMY | .01 |
| 31. Roll Moment due to Pitch Axis Shift of Static Margin | LSMP | .01 |
| 32. Pitch Moment due to Roll Axis Shift of Static Margin | MSMR | .1 |
| 33. Pitch Moment due to Yaw Axis Shift of Static Margin | MSMY | .1 |
| 34. Yaw Moment due to Pitch Axis Shift of Static Margin | NSMP | .1 |
| 35. Yaw Moment due to Roll Axis Shift of Static Margin | NSMR | .1 |
| IB Second Stage Errors | | |
| 36. Propellant Wt Uncertainty | PW20 | .00054 |
| 37. Specific Impulse | ISP2 | .00094 |
| 38. Mass Flow Rate | MFR2 | .01 |
| 39. Thrust Misalignment - Pitch | TMP2 | 1.67 mrad |
| 40. Thrust Misalignment - Yaw | TMY2 | 1.67 mrad |
| 41. Second Stage Aerodynamics (CDO) | CDO2 | .1 |
| 42. Second Stage Aerodynamics ($Cn\alpha$) | CNA2 | .1 |
| 43. Second Stage Aerodynamics ($\xi$) | ZET2 | .1 |
| IC Third Stage Errors | | |
| 44. Propellant Weight Uncertainty | PW30 | .0006 |
| 45. Specific Impulse | ISP3 | .0014 |
| 46. Mass Flow Rate | MFR3 | .018 |
| 47. Thrust Misalignment - Pitch | TMP3 | .557 mrad |
| 48. Thrust Misalignment - Yaw | TMY3 | .557 mrad |
| ID Fourth Stage Errors | | |
| 49. Propellant Weight Uncertainty | PW40 | .00034 |
| 50. Specific Impulse | ISP4 | .006 |

| Description | Symbol | 1σ Mag. Mag. |
|---|---|---|
| 51. Mass Flow Rate | MFR4 | .018 |
| 52. Thrust Misalignment - Pitch | TMP1 | .5 mrad |
| 53. Thrust Misalignment - Yaw | TMY1 | .5 mrad |
| 54. Coning Rate - Pitch | W4CP | .03 rad/sec |
| 55. Coning Rate - Yaw | W4CY | .03 rad/sec |

II. Error Sources Resulting from Investigation

| | Symbol | 1σ Mag. |
|---|---|---|
| **IIA First Stage Errors** | | |
| 56. Proportional Gain Error - Pitch | KPP1 | .0243 |
| 57. Proportional Gain Error - Yaw | KPY1 | .0306 |
| 58. Proportional Gain Error - Roll | KPR1 | .0233 |
| 59. Rate Gain Errors - Pitch | KRP1 | .044 |
| 60. Rate Gain Errors - Yaw | KRY1 | .021 |
| 61. Rate Gain Errors - Roll | KRR1 | .0262 |
| 62. Random Uncompensated Gyro Drift - Pitch | DTEP | $.125 \times 10^{-5}$ rad/sec |
| 63. Random Uncompensated Gyro Drift - Yaw | DTEY | $.200 \times 10^{-5}$ rad/sec |
| 64. Random Uncompensated Gyro Drift - Roll | DTER | $.328 \times 10^{-5}$ rad/sec |
| 65. Mass Unbalance Roll Gyro - Input Axis | KRIA | $1.03 \times 10^{-7}$ rad/sec/ ft/sec$^2$ |
| 66. Mass Unbalance Pitch Gyro - Spin Axis | KPSA | $1.08 \times 10^{-7}$ rad/sec/ ft/sec$^2$ |
| 67. Mass Unbalance Yaw Gyro - Input Axis | KYIA | $1.03 \times 10^{-7}$ rad/sec/ ft/sec$^2$ |
| 68. Anisoelastic Errors - Pitch | KPAN | $3.13 \times 10^{-11}$ rad/sec/ ft$^2$/sec$^4$ |
| 69. Anisoelastic Errors - Roll | KYAN | $3.13 \times 10^{-11}$ rad/sec/ ft$^2$/sec$^4$ |
| 70. Anisoelastic Errors - Yaw | KRAN | $3.13 \times 10^{-11}$ rad/sec/ ft$^2$/sec$^4$ |

| | | Symbol | 1σ Mag. |
|---|---|---|---|
| 71. | Rate Gyro Bias - Pitch | DPBE | 3.57 mrad/sec |
| 72. | Rate Gyro Bias - Yaw | DYBE | 3.57 mrad/sec |
| 73. | Rate Gyro Bias - Roll | DRBE | 3.57 mrad/sec |
| 74. | Rate Gyro Misalignment - Yaw | TYRG | 1.45 mrad |
| 75. | Rate Gyro Misalignment - Roll | TRRG | 1.45 mrad |
| 76. | Vehicle Alignment Errors - Pitch | THOP | $5.76 \times 10^{-5}$ rad |
| 77. | Vehicle Alignment Errors - Yaw | THOY | $5.43 \times 10^{-5}$ rad |
| 78. | Vehicle Alignment Errors - Roll | THOR | $5.25 \times 10^{-5}$ rad |
| 79. | Intervalometer and Torquer Scale Factor | DKSG | .0035 |
| | Fin Misalignment Errors | | |
| 80. | Normal Force Error/Yaw Fins | CNDR | $.576 \times 10^{-4}$ rad |
| 81. | Side Force Error/Pitch Fins | CYDQ | $.576 \times 10^{-4}$ rad |
| 82. | Roll Moment Error/Yaw Fins | CLDR | $.576 \times 10^{-4}$ rad |
| 83. | Roll Moment Error/Pitch Fins | CLDQ | $.576 \times 10^{-4}$ rad |
| 84. | Pitch Moment Error/Yaw Fins | CMDR | $.576 \times 10^{-4}$ rad |
| 85. | Yaw Moment Error/Pitch Fins | NCDQ | $.576 \times 10^{-4}$ rad |
| 86. | Timer Error - First Step | TIM1 | .078 sec. |
| 87. | Timer Error - Second Step | TIM2 | .004 sec. |
| 88. | Timer Error - Third Step | TIM3 | .003 sec. |
| 89. | Timer Error - Fourth Step | TIM4 | .003 sec. |

IIB. Second Stage Errors

| | | | |
|---|---|---|---|
| 90. | Rate Gain Error - Pitch | KRP2 | .044 |
| 91. | Rate Gain Error - Yaw | KRY2 | .026 |
| 92. | Dead Band Error - Pitch | DBP2 | .1 |
| 93. | Dead Band Error - Yaw | DBY2 | .1 |
| 94. | Roll Offset | ROE2 | .25 deg. |
| 95. | Control Motor Misalignment - Pitch axis | C2PY | .0033 deg. |
| 96. | Control Motor Misalignment - Yaw axis | C2YP | .0033 deg. |
| 97. | Timer Error - Sixth Step | TIM6 | .003 sec. |
| 98. | Timer Error - Seventh Step | TIM7 | .003 sec. |

## IIC. Third Stage Errors

| | | Symbol | $1\sigma$ Mag. |
|---|---|---|---|
| 99. | Rate Gain Error - Pitch | KRP3 | .044 |
| 100. | Rate Gain Error - Yaw | KRY3 | .021 |
| 101. | Dead Zone Error - Pitch | DBP3 | .1 |
| 102. | Dead Zone Error - Yaw | DBY3 | .1 |
| 103. | Roll Offset | ROE3 | .25 deg. |

## IID. Fifth Stage Errors

| | | Symbol | $1\sigma$ Mag. |
|---|---|---|---|
| 104. | Mass Flow Rate | MFR5 | .018 |
| 105. | Propellant Weight Uncertainty | PW50 | .00033 |
| 106. | Specific Impulse | ISP5 | .0015 |
| 107. | Fifth Stage Inert Weight | SIW5 | .00033 |
| 108. | Thrust Misalignment, Pitch | TMP5 | .667 mrad |
| 109. | Thrust Misalignment, Yaw | TMY5 | .667 mrad |
| 110. | Coning Rate, Pitch | W5CP | .0463 rad/sec |
| 111. | Coning Rate, Yaw | WSCY | .0463 rad/sec |

## REENTRY MISSION ERROR ANALYSIS RESULTS

The mission input data is received from the Scout Program Office and the nominal trajectory which resulted is presented in Table 2.

Table 3 lists the mean, variances and extreme values of the output parameters and Table 4 is a summary of the most significant error sources and their three sigma contributions to the dispersions in range velocity, flight path angle and inclination.

Tables 5, 6, 7 and 8 are the individual three sigma contributions of each error source to altitude dispersion, velocity, flight path angle and inclination measured at each stage ignition and the nominal 400,000 ft time.

Tables 9 and 10 present the non-linear and cross-term data which went into the Monte Carlo results. In Table 9, there is presented the non-linear data for eight different sources. The position and velocity deviations in a radial, downrange and out-of-plane coordinate system were calculated for an error source input of $+3\sigma$, $+2\sigma$, $+1\sigma$, $-1\sigma$, $-2\sigma$ and $-3\sigma$. The Monte Carlo program then interpolated between these points.

Table 10 displays the cross-term data involving the effects of a pair of error sources acting simultaneously with both sources at their $3\sigma$ level. The sources chosen were all in the control system which will not respond except in the presence of a disturbing force. Thrust misalignment, being the largest disturbing force was chosen to excite these errors. The deviations are represented in the same radial, downrange and out-of-plane coordinate system and they have been normalized by dividing by nine times the product of the two standard deviations. Analysis of these results by comparing the deviations with the $3\sigma$ thrust misalignment deviations indicates no significant cross term effects.

Figures 3-19 depict the cumulative distribution function of each of seventeen output variables.

The results indicate that the velocity dispersion is approximately 15 ft/sec greater than in the polar case examined in Phase I mainly due to increased fourth stage error sensitivities. As an example the specific impulse sensitivity increased from 18.3 ft/sec (3 ) to 132.5 ft/sec. The coning rate effect also increased from 12.3 ft/sec to 107 ft/sec. This increase is partly due to the fact that the errors have been propagated to 400,000 ft whereas in the polar case, they were depicted at fourth stage burnout. While most of the significant error sources showed some increase, the new fourth stage data and pitch profile has evidently enhanced the

effects of the fourth stage errors. The dispersion in flight path angle and inclination also increased from .262 deg and .258 deg respectively to .553 deg and .432 deg (1$\sigma$) due to the increased effect of coning rate errors.

It should be noted that the deviations due to a variation in $C_{m\alpha}$ (CMAL) of .6% (3$\sigma$) was 8 ft and .07 ft/sec. The proper value to use was .15% but an increase in the values by a factor of 25 will still be negligible.

TABLE 2. NOMINAL REENTRY TRAJECTORY PARAMETERS

| Time (sec) | Pitch Rate (deg/sec) |
|---|---|
| 0 | +.0265 |
| 3 | -3.00517 |
| 8 | -.81401 |
| 31 | -.475 |
| 44 | -.37069 |
| 101 | -.18193 |
| 183 | -.20677 |
| 280 | -.15 |
| 305 | -.2 |

Coast Periods:

First Stage Coast - 2.5 sec

Second Stage Coast - -142.22 sec

Third Stage Coast - 21.00 sec

Launch Azimuth - 127.35 deg

Payload Weight - 476 lbs

Launch Position

Latitude (geodetic) - 37.8479 deg

Longitude - -75.4739 deg

Altitude - 0 ft

Fourth Stage Data:

| % of Burn | CG Location Station (Inches) | $I_y$ (slug-ft$^2$) | $I_x$ (slug-ft$^2$) |
|---|---|---|---|
| 0 | 42.7 | 131.6 | 8.62 |
| 20 | 41.2 | 124.6 | 8.16 |
| 40 | 39.2 | 115.5 | 7.50 |
| 60 | 37.1 | 105.0 | 6.57 |
| 80 | 33.8 | 90.6 | 5.42 |
| 100 | 29.4 | 71.5 | 4.01 |

TABLE 2. NOMINAL REENTRY TRAJECTORY PARAMETERS (Cont'd)

Spin Rate - 150 rpm

Conditions at 400,000 ft

- Time - 506.87 sec
- Velocity - 26202 ft/sec
- Flight Path Angle - -3.065 deg
- Inclination - 50.425 deg
- Est. Time of Impact - 861.8 sec
- Est. Velocity at Impact - 26332 ft/sec
- Est. Latitude of Impact - 6.29 deg
- Est. Longitude of Impact - -43.6 deg

TABLE 3. SUMMARY OF THE STATISTICAL DISTRIBUTIONS OF THE OUTPUT PARAMETERS

DISPERSION OF THE SEMIMAJOR AXIS(FT.)

| | | |
|---|---|---|
| MEAN | = | -3.9093911D 04 |
| STANDARD DEVIATION | = | 1.4404841D 05 |
| SMALLEST SAMPLE | = | -7.0428749E 05 |
| 2ND PERCENTILE SAMPLE | = | -3.1352575E 05 |
| 5TH PERCENTILE SAMPLE | = | -2.7359300E 05 |
| 95TH PERCENTILE SAMPLE | = | 1.9867975E 05 |
| 98TH PERCENTILE SAMPLE | = | 2.5663050E 05 |
| LARGEST SAMPLE | = | 3.3841075E 05 |

ECCENTRICITY DISPERSION

| | | |
|---|---|---|
| MEAN | = | 6.2507092D-04 |
| STANDARD DEVIATION | = | 8.4873663D-03 |
| SMALLEST SAMPLE | = | -3.8723297E-02 |
| 2ND PERCENTILE SAMPLE | = | -1.6123567E-02 |
| 5TH PERCENTILE SAMPLE | = | -1.3393990E-02 |
| 95TH PERCENTILE SAMPLE | = | 1.4914967E-02 |
| 98TH PERCENTILE SAMPLE | = | 1.9575126E-02 |
| LARGEST SAMPLE | = | 2.5485134E-02 |

INCLINATION DISPERSION (DEGREES)

| | | |
|---|---|---|
| MEAN | = | 4.7090175D-02 |
| STANDARD DEVIATION | = | 4.3276465D-01 |
| SMALLEST SAMPLE | = | -1.1757078E 00 |
| 2ND PERCENTILE SAMPLE | = | -8.0596161E-01 |
| 5TH PERCENTILE SAMPLE | = | -6.6876984E-01 |
| 95TH PERCENTILE SAMPLE | = | 6.9594288E-01 |
| 98TH PERCENTILE SAMPLE | = | 8.3587742E-01 |
| LARGEST SAMPLE | = | 3.4188604E 00 |

LONG. OF ASCENDING NODE DISPERSION (DEGREES)

| | | |
|---|---|---|
| MEAN | = | -7.6104484D-02 |
| STANDARD DEVIATION | = | 5.6481545D-01 |
| SMALLEST SAMPLE | = | -4.0566330E 00 |
| 2ND PERCENTILE SAMPLE | = | -1.1476784E 00 |
| 5TH PERCENTILE SAMPLE | = | -8.8480568E-01 |
| 95TH PERCENTILE SAMPLE | = | 8.5778236E-01 |
| 98TH PERCENTILE SAMPLE | = | 1.1069622E 00 |
| LARGEST SAMPLE | = | 1.5903816E 00 |

ARGUMENT OF PERIGEE DISPERSION (DEGREES)

| | | |
|---|---|---|
| MEAN | = | 1.4065755D 00 |
| STANDARD DEVIATION | = | 7.5754566D 00 |
| SMALLEST SAMPLE | = | -8.4022601E 01 |
| 2ND PERCENTILE SAMPLE | = | -1.2698379E 01 |
| 5TH PERCENTILE SAMPLE | = | -1.0115087E 01 |
| 95TH PERCENTILE SAMPLE | = | 1.2157968E 01 |
| 98TH PERCENTILE SAMPLE | = | 1.4435243E 01 |
| LARGEST SAMPLE | = | 2.9031933E 01 |

DISPERSION OF ARC LENGTH ALONG ORBIT (NM)

| | | |
|---|---|---|
| MEAN | = | 2.0179964D 00 |
| STANDARD DEVIATION | = | 2.2432839D 01 |
| SMALLEST SAMPLE | = | -6.3985839E 01 |
| 2ND PERCENTILE SAMPLE | = | -4.6811279E 01 |
| 5TH PERCENTILE SAMPLE | = | -3.6878784E 01 |
| 95TH PERCENTILE SAMPLE | = | 3.5184326E 01 |
| 98TH PERCENTILE SAMPLE | = | 4.1909301E 01 |
| LARGEST SAMPLE | = | 1.4571008E 02 |

RADIUS VECTOR DISPERSION (FT)

| | | |
|---|---|---|
| MEAN | = | -5.5997813D 03 |
| STANDARD DEVIATION | = | 4.5084073D 04 |
| SMALLEST SAMPLE | = | -1.3468700E 05 |
| 2ND PERCENTILE SAMPLE | = | -1.0193450E 05 |
| 5TH PERCENTILE SAMPLE | = | -8.0582750E 04 |
| 95TH PERCENTILE SAMPLE | = | 6.8894500E 04 |
| 98TH PERCENTILE SAMPLE | = | 8.3900750E 04 |
| LARGEST SAMPLE | = | 2.8475150E 05 |

INERTIAL VELOCITY DISPERSION (FPS)

| | | |
|---|---|---|
| MEAN | = | -1.5290377D 01 |
| STANDARD DEVIATION | = | 8.7046162D 01 |
| SMALLEST SAMPLE | = | -4.6214233E 02 |
| 2ND PERCENTILE SAMPLE | = | -1.8284058E 02 |
| 5TH PERCENTILE SAMPLE | = | -1.5982788E 02 |
| 95TH PERCENTILE SAMPLE | = | 1.2659253E 02 |
| 98TH PERCENTILE SAMPLE | = | 1.4581518E 02 |
| LARGEST SAMPLE | = | 2.3220508E 02 |

AIRSPEED DISPERSION (FPS)

| | | |
|---|---|---|
| MEAN | = | -1.3847619D 01 |
| STANDARD DEVIATION | = | 8.7753732D 01 |
| SMALLEST SAMPLE | = | -4.7705200E 02 |
| 2ND PERCENTILE SAMPLE | = | -1.8989673E 02 |
| 5TH PERCENTILE SAMPLE | = | -1.6116284E 02 |
| 95TH PERCENTILE SAMPLE | = | 1.2880640E 02 |
| 98TH PERCENTILE SAMPLE | = | 1.4927026E 02 |
| LARGEST SAMPLE | = | 2.3436499E 02 |

INERTIAL FLIGHT PATH ANGLE DISPERSION (DEGREES)

| | | |
|---|---|---|
| MEAN | = | 7.3649899D-02 |
| STANDARD DEVIATION | = | 5.5346475D-01 |
| SMALLEST SAMPLE | = | -3.8355074E 00 |
| 2ND PERCENTILE SAMPLE | = | -1.0032183E 00 |
| 5TH PERCENTILE SAMPLE | = | -7.9017881E-01 |
| 95TH PERCENTILE SAMPLE | = | 9.9063351E-01 |
| 98TH PERCENTILE SAMPLE | = | 1.1529894E 00 |
| LARGEST SAMPLE | = | 1.7027636E 00 |

## ATMOSPHERIC FLIGHT PATH ANGLE DISPERSION (DEGREES)

| | | |
|---|---|---|
| MEAN | = | 7.6369387D-02 |
| STANDARD DEVIATION | = | 5.7456680D-01 |
| SMALLEST SAMPLE | = | -3.9813019E 00 |
| 2ND PERCENTILE SAMPLE | = | -1.0409977E 00 |
| 5TH PERCENTILE SAMPLE | = | -8.2055035E-01 |
| 95TH PERCENTILE SAMPLE | = | 1.0285264E 00 |
| 98TH PERCENTILE SAMPLE | = | 1.1973555E 00 |
| LARGEST SAMPLE | = | 1.7702940E 00 |

## APOGEE DISPERSION (NM)

| | | |
|---|---|---|
| MEAN | = | -4.5542060D 00 |
| STANDARD DEVIATION | = | 4.2657569D 01 |
| SMALLEST SAMPLE | = | -1.7564246E 02 |
| 2ND PERCENTILE SAMPLE | = | -9.0430938E 01 |
| 5TH PERCENTILE SAMPLE | = | -7.8277130E 01 |
| 95TH PERCENTILE SAMPLE | = | 6.7718170E 01 |
| 98TH PERCENTILE SAMPLE | = | 7.7750732E 01 |
| LARGEST SAMPLE | = | 1.3064270E 02 |

## PERIGEE DISPERSION (NM)

| | | |
|---|---|---|
| MEAN | = | -8.3138683D 00 |
| STANDARD DEVIATION | = | 3.5349580D 01 |
| SMALLEST SAMPLE | = | -1.4029141E 02 |
| 2ND PERCENTILE SAMPLE | = | -8.5427520E 01 |
| 5TH PERCENTILE SAMPLE | = | -6.7454193E 01 |
| 95TH PERCENTILE SAMPLE | = | 4.6378967E 01 |
| 98TH PERCENTILE SAMPLE | = | 5.7077331E 01 |
| LARGEST SAMPLE | = | 1.3261713E 02 |

## PERIOD DISPERSION (SEC)

| | | |
|---|---|---|
| MEAN | = | -1.4534739D 01 |
| STANDARD DEVIATION | = | 5.3836084D 01 |
| SMALLEST SAMPLE | = | -2.6143536E 02 |
| 2ND PERCENTILE SAMPLE | = | -1.1690301E 02 |
| 5TH PERCENTILE SAMPLE | = | -1.0205969E 02 |
| 95TH PERCENTILE SAMPLE | = | 7.4510192E 01 |
| 98TH PERCENTILE SAMPLE | = | 9.6305785E 01 |
| LARGEST SAMPLE | = | 1.2711169E 02 |

## LONGITUDE DISPERSION (DEGREES)

| | | |
|---|---|---|
| MEAN | = | -3.1089262D-02 |
| STANDARD DEVIATION | = | 1.1933379D-01 |
| SMALLEST SAMPLE | = | -7.5856495E-01 |
| 2ND PERCENTILE SAMPLE | = | -2.8737736E-01 |
| 5TH PERCENTILE SAMPLE | = | -2.1219063E-01 |
| 95TH PERCENTILE SAMPLE | = | 1.6010284E-01 |
| 98TH PERCENTILE SAMPLE | = | 2.0301723E-01 |
| LARGEST SAMPLE | = | 3.5705853E-01 |

LATITUDE DISPERSION (DGREES)

| | | |
|---|---|---|
| MEAN | = | -8.3753786D-03 |
| STANDARD DEVIATION | = | 1.1141130D-01 |
| SMALLEST SAMPLE | = | -5.4137802E-01 |
| 2ND PERCENTILE SAMPLE | = | -2.0806718E-01 |
| 5TH PERCENTILE SAMPLE | = | -1.7599368E-01 |
| 95TH PERCENTILE SAMPLE | = | 1.8016553E-01 |
| 98TH PERCENTILE SAMPLE | = | 2.2498131E-01 |
| LARGEST SAMPLE | = | 5.1899266E-01 |

ALTITUDE DISPERSION (NM)

| | | |
|---|---|---|
| MEAN | = | -9.2158124D-01 |
| STANDARD DEVIATION | = | 7.4198997D 00 |
| SMALLEST SAMPLE | = | -2.2166505E 01 |
| 2ND PERCENTILE SAMPLE | = | -1.6776343E 01 |
| 5TH PERCENTILE SAMPLE | = | -1.3262297E 01 |
| 95TH PERCENTILE SAMPLE | = | 1.1338453E 01 |
| 98TH PERCENTILE SAMPLE | = | 1.3808164E 01 |
| LARGEST SAMPLE | = | 4.6864604E 01 |

TABLE 4. SIGNIFICANT ERROR SOURCES AND THEIR THREE SIGMA CONTRIBUTIONS AT REENTRY

| Error Source | 1σ Mag. | Altitude (feet) | Velocity (ft/sec) | Flt. Path Angle (deg) | Inclination (deg) |
|---|---|---|---|---|---|
| ISP<br>Specific Impulse - First Stage | .18% | 17084 | | | |
| MFR1<br>Flowrate - First Stage | 1.4% | -42371 | 28.2 | -.296 | |
| DKSG<br>Torquer Scale Factor | .35% | -6434 | 25.0 | | |
| DPBE<br>Pitch Rate Gyro Bias | 3.57 mrad/sec | | -17.4 | | |
| TMP1<br>Pitch Thrust Misalignment - First Stage | 1.67 mrad | 11222 | -113.0 | | |
| TMY1<br>Yaw Thrust Misalignment - First Stage | 1.67 mrad | -8154 | | | |
| CA01<br>Drag coefficient - First Stage | 1% | -6801 | | | |
| DRHO<br>Density | 6.67% | -44285 | 22.2 | -.292 | |
| CDV1<br>Jet Vane Drag | 10% | -4859 | | | |
| TIM1<br>First Timer Switch Uncertainty | .078 sec | 11210 | -48.8 | | |
| ISP2<br>Specific Impulse - Second Stage | .094% | 4102 | 15.2 | | |
| MFR2<br>Flow Rate - Second Stage | 1% | 13575 | | | |
| TMP2<br>Pitch Thrust Misalignment - Second Stage | 1.67 mrad | -19234 | 49.9 | | |
| TMY2<br>Yaw Thrust Misalignment - Second Stage | 1.67 mrad | | | | .216 |
| ISP3<br>Specific Impulse - Third Stage | .14% | | 33.8 | | |
| MFR3<br>Flow Rate - Third Stage | 1.8% | | 87.1 | | |

TABLE 4. (CONTINUED)

| Error Source | 1σ Mag. | Altitude (feet) | Velocity (ft/sec) | Flt. Path Angle (deg) | Inclination (deg) |
|---|---|---|---|---|---|
| TMP3<br>Pitch Thrust Misalignment - Third Stage | .557 mrad | -32652 | 44.0 | -.336 | |
| TMY3<br>Yaw Thrust Misalignment - Third Stage | .557 mrad | | | | .254 |
| ISP4<br>Specific Impulse - Fourth Stage | .6% | | 132.5 | | |
| MFR4<br>Flow Rate - Fourth Stage | 1.8% | | 15.08 | | |
| W4CP<br>Coning Rate - Pitch Axis | .03 rad/sec | 11703 | 29.3 | -.187 | 1.01 |
| W4CY<br>Coning Rate - Yaw axis | .03 rad/sec | 96393 | 107.5 | 1.38 | -.114 |

TABLE 5. INDIVIDUAL THREE SIGMA ERROR SOURCE CONTRIBUTIONS AT SECOND STAGE IGNITION

| CODE | STND.DEV. | RANGE DEVIATION (FT) | VELOCITY DEV. (FPS) | FLT. PATH ANGLE DEV. (DEG) | INCL.DEV. (DEG) |
|---|---|---|---|---|---|
| 1 PW10 | 6.000000E-04 | -1.632500E 02 | -2.879395E 00 | -2.318721E-02 | -2.738479E-03 |
| 2 SIW1 | 8.300000E-03 | -7.202500E 02 | -1.656464E 01 | -1.122539E-01 | -1.686715E-02 |
| 3 SIW2 | 4.100000E-03 | -2.340000E 02 | -5.354370E 00 | -3.655432E-02 | -5.478239E-03 |
| 4 SIW3 | 9.300000E-04 | -7.525000E 01 | -1.725281E 00 | -1.181409E-02 | -1.760054E-03 |
| 5 SIW4 | 2.400000E-03 | -2.175000E 01 | -4.971924E-01 | -3.381370E-03 | -5.101297E-04 |
| 6 ISP1 | 1.800000E-03 | 1.427250E 03 | 3.041516E 01 | 2.157663E-01 | 3.008912E-02 |
| 7 MFR1 | 1.400000E-02 | -1.296750E 03 | -9.471063E 01 | -4.033244E-01 | -1.133363E-01 |
| 8 KRIA | 1.030000E-07 | 0. | 1.123657E-01 | -8.228243E-04 | -4.901514E-03 |
| 9 KPSA | 1.080000E-07 | 1.800000E 01 | -2.202759E-01 | 9.032071E-03 | -7.863255E-04 |
| 10 KYIA | 1.030000E-07 | 0. | -1.151123E-01 | 8.571887E-04 | 5.013786E-03 |
| 11 THOR | 9.250000E-05 | 0. | -1.302490E-01 | 9.382972E-04 | 5.561481E-03 |
| 12 THOP | 5.760000E-05 | -2.350000E 01 | 3.153687E-01 | -1.036844E-02 | 9.771439E-04 |
| 13 THOY | 5.430000E-05 | -5.000000E-01 | -1.219482E-01 | 7.683963E-04 | 4.862668E-03 |
| 14 DTER | 3.280000E-06 | 0. | -7.733154E-02 | 5.675460E-04 | 3.357038E-03 |
| 15 DTEP | 1.250000E-06 | -1.775000E 01 | 2.159424E-01 | -8.546274E-03 | 7.517477E-04 |
| 16 DTEY | 2.000000E-06 | 0. | -1.798096E-01 | 1.315025E-03 | 7.753545E-03 |
| 17 DKSG | 3.500000E-03 | -8.375000E 02 | 9.842834E 00 | -3.833900E-01 | 3.360880E-02 |
| 18 DRBE | 3.570000E-03 | 0. | 2.003723E 00 | -1.446890E-02 | -8.562624E-02 |
| 19 DYBE | 3.570000E-03 | -7.250000E 00 | 2.944763E 00 | -2.301005E-02 | -1.275615E-01 |
| 20 DPBE | 3.570000E-03 | 5.830000E 02 | -7.889099E 00 | 2.575065E-01 | -2.446531E-02 |
| 21 TYRG | 1.450000E-03 | 0. | -2.349854E-02 | 1.666993E-04 | 9.937925E-04 |
| 22 TRRG | 1.450000E-03 | 0. | 0. | -4.268868E-07 | -4.268868E-07 |
| 23 KPP1 | 2.430000E-02 | -1.292500E 02 | 1.723877E 00 | -5.536829E-02 | 5.252415E-03 |
| 24 KPR1 | 3.060000E-02 | 0. | 0. | -4.268868E-07 | -4.268868E-07 |
| 25 KPY1 | 2.330000E-02 | 0. | 1.544189E-02 | -1.203821E-04 | -6.915566E-04 |
| 26 KRP1 | 4.400000E-02 | 8.425000E 01 | -1.167358E 00 | 3.268011E-02 | -3.283186E-03 |
| 27 KRY1 | 2.100000E-02 | 0. | 1.220703E-04 | -1.067217E-06 | -7.683963E-06 |
| 28 KPAN | 3.130000E-11 | -2.500000E-01 | 4.333496E-03 | -1.807866E-04 | 1.451415E-05 |
| 29 KRAN | 3.120000E-11 | 0. | 1.770020E-03 | -1.259316E-05 | -7.726651E-05 |
| 30 KYAN | 3.130000E-11 | 0. | 2.441406E-03 | -1.707547E-05 | -1.054410E-04 |
| 31 CA01 | 10.000000E-03 | -4.722500E 02 | -1.304907E 01 | -8.113389E-02 | -1.189349E-02 |
| 32 CNAL | 2.000000E-01 | -9.175000E 01 | 1.830994E 00 | -2.370076E-02 | 3.571762E-03 |
| 33 CNDQ | 2.000000E-01 | 8.625000E 01 | -9.710083E-01 | 3.367433E-02 | -3.087672E-03 |
| 34 CYBA | 3.300000E-01 | 1.000000E 00 | 2.796021E-01 | -1.697515E-03 | -1.092190E-02 |
| 35 CYDR | 3.300000E-01 | -2.500000E-01 | -4.071045E-02 | 2.294517E-04 | 1.535512E-03 |
| 36 CM01 | 2.000000E-03 | 7.000000E 00 | -9.790039E-02 | 3.506875E-03 | -3.218727E-04 |
| 37 CMDQ | 2.000000E-03 | -3.250000E 00 | 4.705811E-02 | -1.652906E-03 | 1.523986E-04 |
| 38 CMQ1 | 2.000000E-03 | 5.000000E-01 | -8.178711E-03 | 2.106686E-04 | -2.219811E-05 |
| 39 CMAL | 2.000000E-03 | 3.250000E 00 | -5.084229E-02 | 1.014710E-03 | -1.195283E-04 |
| 40 NCBA | 3.300000E-01 | -2.750000E 00 | -3.440552E-01 | 1.591861E-03 | 1.189051E-02 |
| 41 NCDR | 3.300000E-01 | 7.500000E-01 | 1.257935E-01 | -6.851533E-04 | -4.652213E-03 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 42 | NCR1 | 3.300000E-01 | 0. | 7.324219E-04 | -2.347878E-06 | -2.390566E-05 |
| 43 | DRHO | 6.670000E-02 | -2.954000E 03 | -8.883575E 01 | -4.551358E-01 | -1.049480E-01 |
| 44 | FWN1 | 10.000000E-01 | -5.600000E 01 | 1.199286E 01 | -1.716715E-01 | -1.621299E-01 |
| 45 | CNDR | 5.760000E-05 | -5.000000E-01 | 5.920410E-03 | -2.006368E-04 | 1.835613E-05 |
| 46 | CYDQ | 5.760000E-05 | 0. | -3.173828E-03 | 1.728892E-05 | 1.161132E-04 |
| 47 | CLDR | 5.760000E-05 | 0. | -7.324219E-04 | 6.616746E-06 | 4.012736E-05 |
| 48 | CLDQ | 5.760000E-05 | 0. | -2.520752E-02 | 9.348821E-05 | 7.957170E-04 |
| 49 | CMDR | 5.760000E-05 | 0. | 0. | -1.920991E-06 | -4.268868E-07 |
| 50 | NCDQ | 5.760000E-05 | 0. | -6.103516E-04 | 4.482312E-06 | 2.732076E-05 |
| 51 | LSMY | 10.000000E-03 | -2.500000E-01 | -4.748535E-02 | 1.709682E-04 | 1.459526E-03 |
| 52 | LSMP | 10.000000E-03 | -1.400000E 01 | -6.671753E-01 | -5.009090E-03 | -9.113180E-03 |
| 53 | MSMP | 1.000000E-01 | -2.500000E 00 | 3.363037E-02 | 9.873892E-04 | -1.835613E-05 |
| 54 | MSMR | 1.000000E-01 | 3.310000E 02 | -4.749756E 00 | 1.692382E-01 | -1.560399E-02 |
| 55 | NSMY | 1.000000E-01 | 0. | -2.203369E-02 | 1.287064E-04 | 8.426746E-04 |
| 56 | NSMR | 1.000000E-01 | -6.500000E 00 | 2.164246E 00 | -1.832881E-02 | -1.002104E-01 |
| 57 | CDV1 | 1.000000E-01 | -4.097500E 02 | -8.590271E 00 | -6.235344E-02 | -8.522795E-03 |
| 58 | CDV2 | 1.000000E-01 | -1.940000E 02 | -4.062744E 00 | -2.941485E-02 | -4.028531E-03 |
| 59 | CDV3 | 1.000000E-01 | -1.940000E 02 | -4.062744E 00 | -2.941485E-02 | -4.028531E-03 |
| 60 | LDA2 | 1.000000E-01 | -1.782500E 02 | 3.152405E 00 | -8.072302E-02 | 7.161880E-03 |
| 61 | TIM1 | 7.800000E-02 | 1.656000E 03 | -2.099664E 01 | 7.302484E-01 | -6.823444E-02 |
| 62 | TIM2 | 4.000000E-03 | -5.900000E 01 | 6.785278E-01 | -2.574298E-02 | 2.289821E-03 |
| 63 | TIM3 | 3.000000E-03 | -5.000000E 00 | 5.804443E-02 | -2.373918E-03 | 2.061863E-04 |
| 64 | TIM4 | 3.000000E-03 | -7.500000E-01 | 1.013184E-02 | -4.292347E-04 | 3.671227E-05 |
| 65 | TMP1 | 1.670000E-03 | 2.760500E 03 | -7.178174E 01 | 1.484227E 00 | -1.811336E-01 |
| 66 | TMY1 | 1.670000E-03 | -8.280000E 02 | 3.813843E 00 | -2.527712E-01 | -7.446396E-01 |

TABLE 6. INDIVIDUAL THREE SIGMA ERROR SOURCE CONTRIBUTIONS AT THIRD STAGE IGNITION

| CODE | STND.DEV. | RANGE DEVIATION (FT) | VELOCITY DEV. (FPS) | FLT. PATH ANGLE DEV. (DEG) | INCL.DEV. (DEG) |
|---|---|---|---|---|---|
| 1 PW10 | 6.000000E-04 | -7.290000E 02 | -1.808228E 00 | -1.893104E-02 | -4.320095E-04 |
| 2 SIW1 | 8.300000E-03 | -3.710250E 03 | -1.095862E 01 | -1.001280E-01 | -2.637307E-03 |
| 3 SIW2 | 4.100000E-03 | -1.207500E 03 | -3.562744E 00 | -3.252499E-02 | -8.567618E-04 |
| 4 SIW3 | 9.300000E-04 | -3.882500E 02 | -1.144531E 00 | -1.045003E-02 | -2.757689E-04 |
| 5 SIW4 | 2.400000E-03 | -1.120000E 02 | -3.295898E-01 | -2.986020E-03 | -9.135378E-05 |
| 6 ISP1 | 1.800000E-03 | 7.067000E 03 | 1.989832E 01 | 1.881225E-01 | 4.664165E-03 |
| 7 MFR1 | 1.400000E-02 | -1.540200E 04 | -7.029822E 01 | -4.715495E-01 | -1.739564E-02 |
| 8 KRIA | 1.030000E-07 | 5.000000E-01 | 4.174805E-02 | 2.561321E-05 | -2.043507E-03 |
| 9 KPSA | 1.080000E-07 | 5.750000E 01 | -4.805908E-01 | 2.644137E-03 | -1.101368E-04 |
| 10 KYIA | 1.030000E-07 | -7.500000E-01 | -4.357910E-02 | -2.054393E-05 | 2.089184E-03 |
| 11 THOR | 9.250000E-05 | -1.250000E 00 | -4.980469E-02 | -3.623202E-05 | 2.309031E-03 |
| 12 THOP | 5.760000E-05 | -1.087500E 02 | 6.029053E-01 | -2.815799E-03 | 1.331887E-04 |
| 13 THOY | 5.430000E-05 | -3.000000E 00 | -4.858398E-02 | -7.966775E-05 | 2.007222E-03 |
| 14 DTER | 3.280000E-06 | -5.000000E-01 | -2.905273E-02 | -1.734228E-05 | 1.397627E-03 |
| 15 DTEP | 1.250000E-06 | -9.275000E 01 | 4.604492E-01 | -2.476851E-03 | 1.041604E-04 |
| 16 DTEY | 2.000000E-06 | -1.500000E 00 | -6.835938E-02 | -4.188827E-05 | 3.224703E-03 |
| 17 DKSG | 3.500000E-03 | -4.190000E 03 | 2.071436E 01 | -1.109208E-01 | 4.650078E-03 |
| 18 DRBE | 3.570000E-03 | 1.575000E 01 | 7.504883E-01 | 5.339820E-04 | -3.564334E-02 |
| 19 DYBE | 3.570000E-03 | -5.500000E 00 | 1.107056E 00 | 7.993456E-05 | -5.279437E-02 |
| 20 DPBE | 3.570000E-03 | 2.676750E 03 | -1.504687E 01 | 6.955390E-02 | -3.346793E-03 |
| 21 TYRG | 1.450000E-03 | -5.000000E-01 | -9.155273E-03 | -6.936911E-06 | 4.119458E-04 |
| 22 TRRG | 1.450000E-03 | 0. | 0. | 0. | -1.280660E-06 |
| 23 KPP1 | 2.430000E-02 | -5.785000E 02 | 3.250000E 00 | -1.489728E-02 | 7.146085E-04 |
| 24 KPR1 | 3.060000E-02 | 0. | 0. | 0. | -4.268868E-07 |
| 25 KPY1 | 2.330000E-02 | -2.500000E-01 | 5.859375E-03 | 9.071345E-07 | -2.877217E-04 |
| 26 KRP1 | 4.400000E-02 | 3.327500E 02 | -2.041626E 00 | 8.256791E-03 | -4.405472E-04 |
| 27 KRY1 | 2.100000E-02 | -2.500000E-01 | 0. | -4.802477E-07 | -3.415095E-06 |
| 28 KPAN | 3.130000E-11 | -2.250000E 00 | 9.643555E-03 | -5.261380E-05 | 1.280660E-06 |
| 29 KRAN | 3.120000E-11 | -2.500000E-01 | 6.103516E-04 | 4.802477E-07 | -3.244340E-05 |
| 30 KYAN | 3.130000E-11 | -2.500000E-01 | 8.544922E-04 | 7.470519E-07 | -4.439623E-05 |
| 31 CA01 | 10.000000E-03 | -2.743250E 03 | -8.902832E 00 | -7.475605E-02 | -2.072535E-03 |
| 32 CNAL | 2.000000E-01 | -1.665000E 02 | 2.297363E 00 | -2.482027E-03 | 4.478043E-04 |
| 33 CNDQ | 2.000000E-01 | 3.675000E 02 | -1.907837E 00 | 9.348234E-03 | -4.183491E-04 |
| 34 CYBA | 3.300000E-01 | 7.000000E 00 | 1.126709E-01 | 2.090145E-04 | -4.523293E-03 |
| 35 CYDR | 3.300000E-01 | -1.500000E 00 | -1.672363E-02 | -3.740596E-05 | 6.330731E-04 |
| 36 CM01 | 2.000000E-03 | 3.650000E 01 | -1.973877E-01 | 9.838674E-04 | -4.525000E-05 |
| 37 CMDQ | 2.000000E-03 | -1.725000E 01 | 9.362793E-02 | -4.603441E-04 | 1.963679E-05 |
| 38 CMQ1 | 2.000000E-03 | 2.000000E 00 | -1.367188E-02 | 5.053273E-05 | -3.415095E-06 |
| 39 CMAL | 2.000000E-03 | 9.250000E 00 | -7.556152E-02 | 2.049590E-04 | -1.707547E-05 |
| 40 NCBA | 3.300000E-01 | -1.675000E 01 | -1.489258E-01 | -4.624251E-04 | 4.913040E-03 |
| 41 NCDR | 3.300000E-01 | 4.250000E 00 | 5.285645E-02 | 1.268387E-04 | -1.941908E-03 |
| 42 NCR1 | 3.300000E-01 | 0. | 2.441406E-04 | 1.120578E-06 | -1.024528E-05 |

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|---|---|---|---|---|---|---|
| 43 | DRHO | 6.670000E-02 | -1.728000E 04 | -6.444788E 01 | -4.813818E-01 | -1.724068E-02 |
| 44 | FWN1 | 10.000000E-01 | -8.432500E 02 | 1.302698E 01 | -2.579250E-02 | -7.366615E-02 |
| 45 | CNDR | 5.760000E-05 | -2.250000E 00 | 1.135254E-02 | -5.506840E-05 | 1.707547E-06 |
| 46 | CYDQ | 5.760000E-05 | -2.500000E-01 | -1.342773E-03 | -2.934847E-06 | 4.738444E-05 |
| 47 | CLDR | 5.760000E-05 | -2.500000E-01 | -3.662109E-04 | 2.134434E-07 | 1.579481E-05 |
| 48 | CLDQ | 5.760000E-05 | -1.500000E 00 | -1.147461E-02 | -4.258196E-05 | 3.342524E-04 |
| 49 | CMDR | 5.760000E-05 | 0. | 0. | -4.268868E-07 | -1.280660E-06 |
| 50 | NCDQ | 5.760000E-05 | -2.500000E-01 | -2.441406E-04 | 3.201651E-07 | 1.152594E-05 |
| 51 | LSMY | 10.000000E-03 | -3.000000E 00 | -2.221680E-02 | -8.297613E-05 | 6.151439E-04 |
| 52 | LSMP | 10.000000E-03 | -1.412500E 02 | -5.643311E-01 | -4.222017E-03 | -3.482116E-03 |
| 53 | MSMP | 1.000000E-01 | 1.225000E 01 | -6.103516E-03 | 4.902261E-04 | -6.403302E-06 |
| 54 | MSMR | 1.000000E-01 | 1.757250E 03 | -9.553711E 00 | 4.732115E-02 | -2.176696E-03 |
| 55 | NSMY | 1.000000E-01 | -7.500000E-01 | -9.277344E-03 | -1.846285E-05 | 3.521816E-04 |
| 56 | NSMR | 1.000000E-01 | -2.275000E 01 | 7.673340E-01 | -5.236300E-04 | -4.181058E-02 |
| 57 | CDV1 | 1.000000E-01 | -2.013250E 03 | -5.615234E 00 | -5.362734E-02 | -1.328472E-03 |
| 58 | CDV2 | 1.000000E-01 | -9.520000E 02 | -2.647705E 00 | -2.534176E-02 | -6.253892E-04 |
| 59 | CDV3 | 1.000000E-01 | -9.520000E 02 | -2.647705E 00 | -2.534176E-02 | -6.253892E-04 |
| 60 | LDA2 | 1.000000E-01 | -7.677500E 02 | 5.273682E 00 | -1.951572E-02 | 6.202665E-04 |
| 61 | TIM1 | 7.800000E-02 | 7.697250E 03 | -4.161023E 01 | 2.013069E-01 | -9.327477E-03 |
| 62 | TIM2 | 4.000000E-03 | -2.815000E 02 | 1.407593E 00 | -7.366626E-03 | 3.133349E-04 |
| 63 | TIM3 | 3.000000E-03 | -2.600000E 01 | 1.263428E-01 | -6.950251E-04 | 2.774764E-05 |
| 64 | TIM4 | 3.000000E-03 | -4.500000E 00 | 2.270508E-02 | -1.262518E-04 | 3.841981E-06 |
| 65 | TMP1 | 1.670000E-03 | 1.170675E 04 | -1.100439E 02 | 2.993736E-01 | -2.470138E-02 |
| 66 | TMY1 | 1.670000E-03 | -3.587250E 03 | -2.422607E 00 | -9.227762E-02 | -3.077820E-01 |
| 67 | PW20 | 5.400000E-04 | -1.290000E 03 | 5.676270E-02 | -4.970755E-02 | -3.384359E-03 |
| 68 | ISP2 | 9.400000E-04 | 1.343000E 03 | 1.963367E 01 | 4.835475E-02 | 3.017663E-03 |
| 69 | MFR2 | 10.000000E-03 | -5.085500E 03 | -2.583081E 01 | -2.255455E-01 | -1.641849E-02 |
| 70 | KRP2 | 4.400000E-02 | -1.690250E 03 | 5.737671E 00 | -6.760014E-02 | 1.061668E-03 |
| 71 | DBP2 | 1.000000E-01 | -1.224250E 03 | 3.285889E 00 | -4.803880E-02 | 9.913593E-03 |
| 72 | KRY2 | 2.620000E-02 | -4.400000E 02 | 1.869385E 00 | -1.973423E-02 | -5.488911E-03 |
| 73 | DBY2 | 1.000000E-01 | 5.332500E 02 | -1.561279E-01 | 2.118901E-02 | -8.543457E-02 |
| 74 | ROE2 | 2.500000E-01 | 1.865000E 02 | -1.711304E 00 | 7.721315E-03 | 5.201659E-02 |
| 75 | C2PY | 3.300000E-03 | 0. | 0. | 0. | -4.268868E-07 |
| 76 | C2YP | 3.300000E-03 | -2.500000E-01 | -2.441406E-04 | -1.067217E-07 | 4.695755E-06 |
| 77 | CDO2 | 1.000000E-01 | -1.109750E 03 | 1.013672E 00 | -4.235331E-02 | 3.213604E-03 |
| 78 | CNA2 | 1.000000E-01 | -4.602500E 02 | 1.898438E 00 | -1.757968E-02 | -1.551435E-02 |
| 79 | ZET2 | 1.000000E-01 | -1.386000E 03 | 4.847656E 00 | -5.369174E-02 | -6.321340E-03 |
| 80 | TIM6 | 3.000000E-03 | 0. | 0. | 0. | -4.268868E-07 |
| 81 | TIM7 | 3.000000E-03 | 0. | 7.080078E-03 | 1.707547E-06 | -3.423632E-04 |
| 82 | TMP2 | 1.670000E-03 | -9.476000E 03 | 3.238074E 01 | -3.778859E-01 | 2.104552E-03 |
| 83 | TMY2 | 1.670000E-03 | -1.712750E 03 | -7.341675E 00 | -6.670587E-02 | 6.049046E-01 |

TABLE 7. INDIVIDUAL THREE SIGMA ERROR SOURCE CONTRIBUTIONS AT FOURTH STAGE IGNITION

| | CODE | STND.DEV. | RANGE DEVIATION (FT) | VELOCITY DEV. (FPS) | FLT. PATH ANGLE DEV. (DEG) | INCL.DEV. (DEG) |
|---|---|---|---|---|---|---|
| 1 | PW10 | 6.000000E-04 | -9.962500E 02 | -1.245361E 00 | -1.199771E-02 | -1.233703E-04 |
| 2 | SIW1 | 8.300000E-03 | -5.142750E 03 | -7.955078E 00 | -6.465570E-02 | -6.313656E-04 |
| 3 | SIW2 | 4.100000E-03 | -1.673750E 03 | -2.586670E 00 | -2.104772E-02 | -2.446061E-04 |
| 4 | SIW3 | 9.300000E-04 | -5.372500E 02 | -8.308105E-01 | -6.756831E-03 | -7.129010E-05 |
| 5 | SIW4 | 2.400000E-03 | -1.550000E 02 | -2.395020E-01 | -1.957356E-03 | -2.219811E-05 |
| 6 | ISP1 | 1.800000E-03 | 9.756250E 03 | 1.423853E 01 | 1.210616E-01 | 1.305420E-03 |
| 7 | MFR1 | 1.400000E-02 | -2.236050E 04 | -5.593188E 01 | -3.200459E-01 | -4.846873E-03 |
| 8 | KRIA | 1.030000E-07 | 1.250000E 00 | 1.977539E-02 | 3.359066E-05 | -9.762901E-04 |
| 9 | KPSA | 1.080000E-07 | 1.240000E 02 | -5.427246E-01 | 9.507170E-04 | -2.518632E-05 |
| 10 | KYIA | 1.030000E-07 | -1.250000E 00 | -2.099609E-02 | -3.205653E-05 | 9.997689E-04 |
| 11 | THOR | 9.250000E-05 | -2.000000E 00 | -2.441406E-02 | -4.439623E-05 | 1.099660E-03 |
| 12 | THOP | 5.760000E-05 | -1.347500E 02 | 6.669922E-01 | -9.094157E-04 | 2.860142E-05 |
| 13 | THOY | 5.430000E-05 | -4.000000E 00 | -2.465820E-02 | -6.927573E-05 | 9.476887E-04 |
| 14 | DTER | 3.280000E-06 | -1.000000E 00 | -1.391602E-02 | -2.277174E-05 | 6.667972E-04 |
| 15 | DTEP | 1.250000E-06 | -1.170000E 02 | 5.187988E-01 | -8.781062E-04 | 2.262500E-05 |
| 16 | DTEY | 2.000000E-06 | -2.250000E 00 | -3.320313E-02 | -5.604223E-05 | 1.538500E-03 |
| 17 | DKSG | 3.500000E-03 | -5.278250E 03 | 2.330664E 01 | -3.923161E-02 | 1.016844E-03 |
| 18 | DRBE | 3.570000E-03 | 2.850000E 01 | 3.586426E-01 | 6.488813E-04 | -1.697259E-02 |
| 19 | DYBE | 3.570000E-03 | 4.500000E 00 | 5.400391E-01 | 5.657584E-04 | -2.493659E-02 |
| 20 | DPBE | 3.570000E-03 | 3.320750E 03 | -1.662720E 01 | 2.225718E-02 | -7.257076E-04 |
| 21 | TYRG | 1.450000E-03 | -5.000000E-01 | -4.394531E-03 | -8.084169E-06 | 1.946604E-04 |
| 22 | TRRG | 1.450000E-03 | 0. | 0. | 2.934847E-07 | -4.268868E-07 |
| 23 | KPP1 | 2.430000E-02 | -7.160000E 02 | 3.586914E 00 | -4.734989E-03 | 1.536793E-04 |
| 24 | KPR1 | 3.060000E-02 | 0. | 0. | 1.467423E-07 | -4.268868E-07 |
| 25 | KPY1 | 2.330000E-02 | 0. | 2.685547E-03 | 2.881486E-06 | -1.370307E-04 |
| 26 | KRP1 | 4.400000E-02 | 4.050000E 02 | -2.222168E 00 | 2.347837E-03 | -9.391510E-05 |
| 27 | KRY1 | 2.100000E-02 | 0. | 0. | -0. | -2.134434E-06 |
| 28 | KPAN | 3.130000E-11 | -2.500000E 00 | 1.074219E-02 | -1.890308E-05 | 0. |
| 29 | KRAN | 3.120000E-11 | 0. | 4.882813E-04 | 4.669075E-07 | -1.579481E-05 |
| 30 | KYAN | 3.130000E-11 | 0. | 4.882813E-04 | 1.213959E-06 | -2.177123E-05 |
| 31 | CA01 | 10.000000E-03 | -3.326000E 03 | -6.055420E 00 | -4.936472E-02 | -5.716014E-04 |
| 32 | CNAL | 2.000000E-01 | -1.577500E 02 | 2.308105E 00 | 1.191708E-03 | 8.708491E-05 |
| 33 | CNDQ | 2.000000E-01 | 4.560000E 02 | -2.122070E 00 | 3.103841E-03 | -8.793868E-05 |
| 34 | CYBA | 3.300000E-01 | 1.100000E 01 | 5.883789E-02 | 1.759307E-04 | -2.142118E-03 |
| 35 | CYDR | 3.300000E-01 | -2.000000E 00 | -8.789063E-03 | -3.013554E-05 | 2.983939E-04 |
| 36 | CM01 | 2.000000E-03 | 4.600000E 01 | -2.199707E-01 | 3.351595E-04 | -1.067217E-05 |
| 37 | CMDQ | 2.000000E-03 | -2.150000E 01 | 1.044922E-01 | -1.552267E-04 | 4.268868E-06 |
| 38 | CMQ1 | 2.000000E-03 | 2.500000E 00 | -1.489258E-02 | 1.326017E-05 | -1.280660E-06 |
| 39 | CMAL | 2.000000E-03 | 1.075000E 01 | -7.934570E-02 | 3.034898E-05 | -3.841981E-06 |
| 40 | NCBA | 3.300000E-01 | -2.400000E 01 | -8.300781E-02 | -3.438707E-04 | 2.317995E-03 |
| 41 | NCDR | 3.300000E-01 | 6.500000E 00 | 2.880859E-02 | 9.970475E-05 | -9.263444E-04 |
| 42 | NCR1 | 3.300000E-01 | 0. | 2.441406E-04 | 1.200619E-06 | -5.976415E-06 |

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|---|---|---|---|---|---|---|
| 43 | DRHO | 6.670000E-02 | -2.431700E 04 | -4.989746E 01 | -3.221433E-01 | -5.079099E-03 |
| 44 | FWN1 | 10.000000E-01 | -9.950000E 02 | 1.269873E 01 | -2.518632E-03 | -3.630288E-02 |
| 45 | CNDR | 5.760000E-05 | -2.750000E 00 | 1.269531E-02 | -1.803597E-05 | 0. |
| 46 | CYDQ | 5.760000E-05 | -2.500000E-01 | -7.324219E-04 | -2.601342E-06 | 2.262500E-05 |
| 47 | CLDR | 5.760000E-05 | 0. | 0. | 2.934847E-07 | 8.110849E-06 |
| 48 | CLDQ | 5.760000E-05 | -2.000000E 00 | -6.591797E-03 | -3.057577E-05 | 1.605094E-04 |
| 49 | CMDR | 5.760000E-05 | 0. | 2.441406E-04 | -4.402270E-07 | 0. |
| 50 | NCDQ | 5.760000E-05 | 0. | 0. | 1.467423E-07 | 5.549529E-06 |
| 51 | LSMY | 10.000000E-03 | -4.000000E 00 | -1.318359E-02 | -5.980417E-05 | 2.958326E-04 |
| 52 | LSMP | 10.000000E-03 | -2.035000E 02 | -4.697266E-01 | -2.844547E-03 | -1.601679E-03 |
| 53 | MSMP | 1.000000E-01 | 1.925000E 01 | -1.977539E-02 | 2.731542E-04 | -2.561321E-06 |
| 54 | MSMR | 1.000000E-01 | 2.210250E 03 | -1.064917E 01 | 1.603543E-02 | -4.845165E-04 |
| 55 | NSMY | 1.000000E-01 | -1.000000E 00 | -4.882813E-03 | -1.511446E-05 | 1.681934E-04 |
| 56 | NSMR | 1.000000E-01 | -2.350000E 01 | 3.430176E-01 | 3.317711E-05 | -1.997660E-02 |
| 57 | CDV1 | 1.000000E-01 | -2.777500E 03 | -4.010986E 00 | -3.443234E-02 | -3.726722E-04 |
| 58 | CDV2 | 1.000000E-01 | -1.313000E 03 | -1.889648E 00 | -1.626804E-02 | -1.750236E-04 |
| 59 | CDV3 | 1.000000E-01 | -1.313000E 03 | -1.889648E 00 | -1.626804E-02 | -1.750236E-04 |
| 60 | LDA2 | 1.000000E-01 | -9.320000E 02 | 5.686279E 00 | -5.180565E-03 | -2.134434E-06 |
| 61 | TIM1 | 7.800000E-02 | 9.586000E 03 | -4.624512E 01 | 6.631096E-02 | -2.025151E-03 |
| 62 | TIM2 | 4.000000E-03 | -3.525000E 02 | 1.579346E 00 | -2.561401E-03 | 6.830189E-05 |
| 63 | TIM3 | 3.000000E-03 | -3.250000E 01 | 1.428223E-01 | -2.496354E-04 | 5.549529E-06 |
| 64 | TIM4 | 3.000000E-03 | -6.000000E 00 | 2.587891E-02 | -4.583697E-05 | 1.280660E-06 |
| 65 | TMP1 | 1.670000E-03 | 1.372025E 04 | -1.158186E 02 | 4.816300E-02 | -5.493180E-03 |
| 66 | TMY1 | 1.670000E-03 | -4.842250E 03 | -3.159668E 00 | -5.570474E-02 | -1.441494E-01 |
| 67 | PW20 | 5.400000E-04 | -1.917500E 03 | 1.395264E 00 | -2.661299E-02 | -1.747248E-03 |
| 68 | ISP2 | 9.400000E-04 | 2.225500E 03 | 1.788330E 01 | 4.357530E-02 | 3.462052E-04 |
| 69 | MFR2 | 10.000000E-03 | -8.245000E 03 | -1.926489E 01 | -1.417127E-01 | -6.825493E-03 |
| 70 | KRP2 | 4.400000E-02 | -2.465500E 03 | 7.485840E 00 | -3.104270E-02 | 1.152594E-04 |
| 71 | DBP2 | 1.000000E-01 | -1.784750E 03 | 4.636963E 00 | -2.270690E-02 | 4.712830E-03 |
| 72 | KRY2 | 2.620000E-02 | -7.237500E 02 | 2.095947E 00 | -1.010090E-02 | -2.878925E-03 |
| 73 | DBY2 | 1.000000E-01 | 7.892500E 02 | -1.603271E 00 | 1.046294E-02 | -4.250811E-02 |
| 74 | RDE2 | 2.500000E-01 | 2.665000E 02 | -1.374756E 00 | 3.034912E-03 | 2.598119E-02 |
| 75 | C2PY | 3.300000E-03 | 0. | 0. | -0. | -4.268868E-07 |
| 76 | C2YP | 3.300000E-03 | 0. | 0. | -1.467423E-07 | 2.134434E-06 |
| 77 | CD02 | 1.000000E-01 | -1.630250E 03 | 2.192871E 00 | -2.174895E-02 | 1.503495E-03 |
| 78 | CNA2 | 1.000000E-01 | -6.575000E 02 | 2.186768E 00 | -7.831746E-03 | -7.863255E-03 |
| 79 | ZET2 | 1.000000E-01 | -1.998000E 03 | 6.157715E 00 | -2.443878E-02 | -3.473578E-03 |
| 80 | TIM6 | 3.000000E-03 | 0. | 0. | -0. | -4.268868E-07 |
| 81 | TIM7 | 3.000000E-03 | 2.500000E-01 | 3.417969E-03 | 4.282208E-06 | -1.724623E-04 |
| 82 | TMP2 | 1.670000E-03 | -1.382100E 04 | 4.203931E 01 | -1.736029E-01 | -1.265719E-03 |
| 83 | TMY2 | 1.670000E-03 | -2.596000E 03 | -7.373047E-02 | -3.778638E-02 | 2.999832E-01 |
| 84 | PW30 | 6.000000E-04 | -2.200000E 01 | -5.576904E 00 | -2.393781E-03 | -4.448161E-04 |
| 85 | ISP3 | 1.400000E-03 | 1.030000E 02 | 3.610327E 01 | 1.330681E-02 | 2.869106E-03 |
| 86 | MFR3 | 1.800000E-02 | 4.657500E 02 | -8.956714E 01 | 1.271719E-02 | -7.111081E-03 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 87 | KRP3 | 4.400000E-02 | 0. | 0. | -0. | -4.268868E-07 |
| 88 | KRY3 | 4.400000E-02 | 0. | 0. | -0. | -4.268868E-07 |
| 89 | DPB3 | 1.000000E-01 | 0. | 0. | -0. | -4.268868E-07 |
| 90 | DYB3 | 1.000000E-01 | 0. | 0. | -0. | -4.268868E-07 |
| 91 | ROE3 | 2.500000E-01 | -1.250000E 00 | -2.814941E-01 | -1.549999E-04 | 1.560314E-02 |
| 92 | TMP3 | 5.570000E-04 | -9.398750E 03 | 1.215845E 01 | -4.961402E-01 | -2.916918E-03 |
| 93 | TMY3 | 5.570000E-04 | -1.095000E 02 | -7.263428E 00 | -7.739458E-03 | 3.553303E-01 |

TABLE 8. INDIVIDUAL THREE SIGMA ERROR SOURCE CONTRIBUTIONS AT RE-ENTRY

TRW SYSTEMS

| | CODE | STND.DEV. | RANGE DEVIATION (FT) | VELOCITY DEV. (FPS) | FLT. PATH ANGLE DEV. (DEG) | INCL.DEV. (DEG) |
|---|---|---|---|---|---|---|
| 1 | PW10 | 6.000000E-04 | -1.715500E 03 | -2.482910E-01 | -1.023037E-02 | -6.061793E-05 |
| 2 | SIW1 | 8.300000E-03 | -9.567500E 03 | -2.534424E 00 | -5.602836E-02 | -3.573043E-04 |
| 3 | SIW2 | 4.100000E-03 | -2.950000E 03 | -8.178711E-01 | -1.838332E-02 | -1.186745E-04 |
| 4 | SIW3 | 9.300000E-04 | -9.485000E 02 | -2.629395E-01 | -5.901310E-03 | -3.884670E-05 |
| 5 | SIW4 | 2.400000E-03 | -2.735000E 02 | -1.088623E 00 | -1.831078E-03 | -1.109906E-05 |
| 6 | ISP1 | 1.800000E-03 | 1.708425E 04 | 4.093262E 00 | 1.050130E-01 | 6.322194E-04 |
| 7 | MFR1 | 1.400000E-02 | -4.237125E 04 | -2.826758E 01 | -2.963465E-01 | -2.360257E-03 |
| 8 | KRIA | 1.030000E-07 | 3.500000E 00 | 1.000977E-02 | 3.617866E-05 | -6.083137E-04 |
| 9 | KPSA | 1.080000E-07 | 1.530000E 02 | -5.869141E-01 | 8.217571E-05 | -9.391510E-06 |
| 10 | KYIA | 1.030000E-07 | -3.250000E 00 | -1.196289E-02 | -3.663222E-05 | 6.215472E-04 |
| 11 | THOR | 9.250000E-05 | -5.000000E 00 | -1.367188E-02 | -4.810481E-05 | 6.791769E-04 |
| 12 | THOP | 5.760000E-05 | -1.557500E 02 | 6.999512E-01 | 9.530248E-05 | 9.818397E-06 |
| 13 | THOY | 5.430000E-05 | -8.750000E 00 | -1.318359E-02 | -6.811513E-05 | 5.814198E-04 |
| 14 | DTER | 3.280000E-06 | -2.750000E 00 | -7.812500E-03 | -2.561321E-05 | 4.136533E-04 |
| 15 | DTEP | 1.250000E-06 | -1.430000E 02 | 5.576172E-01 | -5.546861E-05 | 7.683963E-06 |
| 16 | DTEY | 2.000000E-06 | -6.250000E 00 | -1.855469E-02 | -6.187191E-05 | 9.532383E-04 |
| 17 | DKSG | 3.500000E-03 | -6.434000E 03 | 2.504932E 01 | -2.303214E-03 | 3.850519E-04 |
| 18 | DRBE | 3.570000E-03 | 7.075000E 01 | 1.901855E-01 | 6.920102E-04 | -1.051123E-02 |
| 19 | DYBE | 3.570000E-03 | 4.525000E 01 | 3.188477E-01 | 7.407553E-04 | -1.530987E-02 |
| 20 | DPBE | 3.570000E-03 | 3.816250E 03 | -1.742261E 01 | -2.701206E-03 | -2.744882E-04 |
| 21 | TYRG | 1.450000E-03 | -1.000000E 00 | -2.441406E-03 | -8.431015E-06 | 1.199552E-04 |
| 22 | TRRG | 1.450000E-03 | 0. | -2.441406E-04 | 1.600826E-07 | -8.537736E-07 |
| 23 | KPP1 | 2.430000E-02 | -8.190000E 02 | 3.752686E 00 | 6.365149E-04 | 5.677595E-05 |
| 24 | KPR1 | 3.060000E-02 | 0. | 0. | -0. | -8.537736E-07 |
| 25 | KPY1 | 2.330000E-02 | 2.500000E-01 | 1.464844E-03 | 3.895342E-06 | -8.623114E-05 |
| 26 | KRP1 | 4.400000E-02 | 4.347500E 02 | -2.279297E 00 | -8.421943E-04 | -3.543161E-05 |
| 27 | KRY1 | 2.100000E-02 | -2.500000E-01 | -4.882813E-04 | -3.201651E-07 | -2.134434E-06 |
| 28 | KPAN | 3.130000E-11 | -3.000000E 00 | 1.123047E-02 | -2.374558E-06 | -8.537736E-07 |
| 29 | KRAN | 3.120000E-11 | 0. | -2.441406E-04 | -1.600826E-07 | -1.024528E-05 |
| 30 | KYAN | 3.130000E-11 | 2.500000E-01 | 0. | 1.520784E-06 | -1.451415E-05 |
| 31 | TMP1 | 1.670000E-03 | 1.122250E 04 | -1.130752E 02 | -9.802212E-02 | -2.144679E-03 |
| 32 | TMY1 | 1.670000E-03 | -8.154750E 03 | 4.169922E-01 | -4.629772E-02 | -8.775640E-02 |
| 33 | CA01 | 10.000000E-03 | -6.801000E 03 | -2.416992E 00 | -4.378738E-02 | -2.744882E-04 |
| 34 | CNAL | 2.000000E-01 | 1.925000E 01 | 2.082275E 00 | 3.632860E-03 | 2.732076E-05 |
| 35 | CNDQ | 2.000000E-01 | 5.337500E 02 | -2.244629E 00 | -1.537326E-04 | -3.329717E-05 |
| 36 | CYBA | 3.300000E-01 | 2.200000E 01 | 2.905273E-02 | 1.712083E-04 | -1.319507E-03 |
| 37 | CYDR | 3.300000E-01 | -4.000000E 00 | -4.638672E-03 | -2.942851E-05 | 1.818538E-04 |
| 38 | CM01 | 2.000000E-03 | 5.500000E 01 | -2.343750E-01 | -3.655218E-06 | -4.695755E-06 |
| 39 | CMDQ | 2.000000E-03 | -2.575000E 01 | 1.098633E-01 | 4.188827E-06 | 8.537736E-07 |
| 40 | CMQ1 | 2.000000E-03 | 2.500000E 00 | -1.538086E-02 | -7.337117E-06 | -1.280660E-06 |
| 41 | CMAL | 2.000000E-03 | 8.750000E 00 | -7.763672E-02 | -7.086321E-05 | -2.134434E-06 |

TRW SYSTEMS

| | | | | | | |
|---|---|---|---|---|---|---|
| 42 | NCBA | 3.300000E-01 | -4.550000E 01 | -3.857422E-02 | -3.205120E-04 | 1.419399E-03 |
| 43 | NCDR | 3.300000E-01 | 1.275000E 01 | 1.391602E-02 | 9.530248E-05 | -5.745897E-04 |
| 44 | NCR1 | 3.300000E-01 | 0. | 0. | 5.069281E-07 | -2.988208E-06 |
| 45 | DRHO | 6.670000E-02 | -4.428575E 04 | -2.227466E 01 | -2.927699E-01 | -2.551076E-03 |
| 46 | FWN1 | 10.000000E-01 | -6.302500E 02 | 1.199878E 01 | 1.177159E-02 | -2.296438E-02 |
| 47 | CNDR | 5.760000E-05 | -3.250000E 00 | 1.293945E-02 | 1.120578E-06 | 0. |
| 48 | CYDQ | 5.760000E-05 | -5.000000E-01 | -7.324219E-04 | -2.614682E-06 | 1.280660E-05 |
| 49 | CLDR | 5.760000E-05 | 0. | -2.441406E-04 | 2.668043E-07 | 3.415095E-06 |
| 50 | CLDQ | 5.760000E-05 | -4.000000E 00 | -3.417969E-03 | -2.854806E-05 | 9.946463E-05 |
| 51 | CMDR | 5.760000E-05 | 0. | -4.882813E-04 | -3.735260E-07 | 0. |
| 52 | NCDQ | 5.760000E-05 | -2.500000E-01 | -4.882813E-04 | -1.067217E-07 | 1.707547E-06 |
| 53 | LSMY | 10.000000E-03 | -7.750000E 00 | -6.591797E-03 | -5.525516E-05 | 1.844151E-04 |
| 54 | LSMP | 10.000000E-03 | -3.815000E 02 | -2.346191E-01 | -2.622739E-03 | -9.707406E-04 |
| 55 | MSMP | 1.000000E-01 | 3.375000E 01 | -4.028320E-02 | 1.856157E-04 | -2.134434E-06 |
| 56 | MSMR | 1.000000E-01 | 2.634500E 03 | -1.130127E 01 | -3.160830E-04 | -1.891109E-04 |
| 57 | NSMY | 1.000000E-01 | -2.000000E 00 | -2.929688E-03 | -1.526120E-05 | 1.041604E-04 |
| 58 | NSMR | 1.000000E-01 | -1.800000E 01 | 2.058105E-01 | 1.904716E-04 | -1.241600E-02 |
| 59 | CDV1 | 1.000000E-01 | -4.859000E 03 | -1.125977E 00 | -2.983245E-02 | -1.818538E-04 |
| 60 | CDV2 | 1.000000E-01 | -2.296250E 03 | -5.275879E-01 | -1.408580E-02 | -8.623114E-05 |
| 61 | CDV3 | 1.000000E-01 | -2.296250E 03 | -5.275879E-01 | -1.408580E-02 | -8.623114E-05 |
| 62 | LDA2 | 1.000000E-01 | -9.662500E 02 | 5.767822E 00 | 2.714840E-03 | -6.104481E-05 |
| 63 | TIM1 | 7.800000E-02 | 1.121025E 04 | -4.880249E 01 | -4.254487E-03 | -7.649812E-04 |
| 64 | TIM2 | 4.000000E-03 | -4.252500E 02 | 1.689697E 00 | -7.966775E-05 | 2.475944E-05 |
| 65 | TIM3 | 3.000000E-03 | -4.050000E 01 | 1.538086E-01 | -2.201135E-05 | 1.707547E-06 |
| 66 | TIM4 | 3.000000E-03 | -7.500000E 00 | 2.758789E-02 | -4.562353E-06 | 0. |
| 67 | PW20 | 5.400000E-04 | -2.838500E 03 | 2.731934E 00 | -1.811617E-02 | -1.285356E-03 |
| 68 | ISP2 | 9.400000E-04 | 4.102500E 03 | 1.518408E 01 | 4.571144E-02 | -1.494104E-05 |
| 69 | MFR2 | 10.000000E-03 | -1.357575E 04 | -1.153906E 01 | -1.162648E-01 | -4.641113E-03 |
| 70 | KRP2 | 4.400000E-02 | -3.432000E 03 | 8.912842E 00 | -1.643271E-02 | -2.134434E-05 |
| 71 | DBP2 | 1.000000E-01 | -2.506500E 03 | 5.729492E 00 | -1.266170E-02 | 3.348073E-03 |
| 72 | KRY2 | 2.620000E-02 | -9.515000E 02 | 2.811279E 00 | 1.551408E-02 | -2.233472E-03 |
| 73 | DBY2 | 1.000000E-01 | 1.121250E 03 | -2.367188E 00 | 5.926710E-03 | -3.070725E-02 |
| 74 | ROE2 | 2.500000E-01 | 3.552500E 02 | -1.344238E 00 | 1.298376E-03 | 1.879070E-02 |
| 75 | C2PY | 3.300000E-03 | 0. | 0. | -0. | -8.537736E-07 |
| 76 | C2YP | 3.300000E-03 | 0. | -7.324219E-04 | -5.069281E-07 | 1.707547E-06 |
| 77 | CD02 | 1.000000E-01 | -2.362750E 03 | 3.276855E 00 | -1.393719E-02 | 1.059533E-03 |
| 78 | CNA2 | 1.000000E-01 | -8.975000E 02 | 2.492188E 00 | -3.964551E-03 | -5.716868E-03 |
| 79 | ZET2 | 1.000000E-01 | -2.754250E 03 | 7.253662E 00 | -1.274228E-02 | -2.592057E-03 |
| 80 | TIM6 | 3.000000E-03 | 0. | -2.441406E-04 | 3.735260E-07 | -8.537736E-07 |
| 81 | TIM7 | 3.000000E-03 | 2.500000E-01 | 1.953125E-03 | 4.989240E-06 | -1.255047E-04 |
| 82 | TMP2 | 1.670000E-03 | -1.923400E 04 | 4.999365E 01 | -9.186353E-02 | -1.502642E-03 |
| 83 | TMY2 | 1.670000E-03 | -3.876750E 03 | 3.471191E 00 | -2.523245E-02 | 2.164222E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 84 | PW30 | 6.000000E-04 | -2.707500E 02 | -5.211914E 00 | -6.538972E-03 | -2.309458E-04 |
| 85 | ISP3 | 1.400000E-03 | 1.605250E 03 | 3.388672E 01 | 4.065854E-02 | 1.481297E-03 |
| 86 | MFR3 | 1.800000E-02 | -9.407500E 02 | -8.717285E 01 | -6.659469E-02 | -3.652017E-03 |
| 87 | KRP3 | 4.400000E-02 | 0. | 0. | 1.067217E-07 | -8.537736E-07 |
| 88 | DPB3 | 1.000000E-01 | 0. | 0. | 1.067217E-07 | -8.537736E-07 |
| 89 | KRY3 | 4.400000E-02 | 0. | 0. | 1.067217E-07 | -8.537736E-07 |
| 90 | DYB3 | 1.000000E-01 | 0. | 0. | 1.067217E-07 | -8.537736E-07 |
| 91 | RDE3 | 2.500000E-01 | -1.325000E 01 | -1.870117E-01 | -2.774764E-04 | 1.119169E-02 |
| 92 | TMP3 | 5.570000E-04 | -3.265275E 04 | 4.408228E 01 | -3.365800E-01 | -2.219385E-03 |
| 93 | TMY3 | 5.570000E-04 | -6.030000E 02 | -5.001953E 00 | -1.021351E-02 | 2.542845E-01 |
| 94 | PW40 | 3.400000E-04 | -2.900000E 01 | -2.399902E 00 | -1.708561E-03 | -1.084293E-04 |
| 95 | ISP4 | 6.000000E-03 | 1.557500E 03 | 1.325979E 02 | 9.266979E-02 | 5.911102E-03 |
| 96 | MFR4 | 1.800000E-02 | -1.534250E 03 | -1.508081E 01 | -8.276204E-02 | -7.10040[illegible]E-03 |
| 97 | TMP4 | 5.000000E-04 | -2.305250E 03 | 1.242188E 00 | -3.381037E-02 | -2.843152E-02 |
| 98 | TMY4 | 5.000000E-04 | -2.745250E 03 | 1.900879E 00 | -3.987310E-02 | 2.392530E-02 |
| 99 | W4CP | 3.000000E-02 | -1.170300E 04 | -2.936719E 01 | -1.878927E-01 | 1.011932E 00 |
| 100 | W4CY | 3.000000E-02 | 9.639325E 04 | -1.075078E 02 | 1.382834E 00 | 1.144360E-01 |

TABLE 9. DATA FROM NON-LINEAR CARDS

| CODE | STND.DEV. | POSITION DEVIATIONS | | | VELOCITY DEVIATIONS | | |
|---|---|---|---|---|---|---|---|
| MP1 | 1.670000E-03 | | | | | | |
| | | 1.113800E 04 | -6.000900E 04 | 1.141500E 03 | 3.479100E 01 | -1.113900E 02 | 2.028500E 00 |
| | | 8.006920E 03 | -4.012630E 04 | 7.692140E 02 | 2.316920E 01 | -7.510120E 01 | 1.339610E 00 |
| | | 4.279310E 03 | -2.216790E 04 | 3.847650E 02 | 1.196220E 01 | -3.726400E 01 | 6.672910E-01 |
| | | -8.591160E 03 | 1.684920E 04 | -2.400310E 02 | -2.366270E 01 | 3.129220E 01 | -4.090330E-01 |
| | | -1.718020E 04 | 3.366270E 04 | -4.816920E 02 | -4.729150E 01 | 6.250000E 01 | -8.182680E-01 |
| | | -2.577600E 04 | 5.047100E 04 | -7.195600E 02 | -7.068500E 01 | 9.368600E 01 | -1.227900E 00 |
| MY1 | 1.670000E-03 | | | | | | |
| | | -8.204700E 03 | -6.210900E 02 | 4.620500E 04 | -2.058500E 01 | -8.241400E-01 | 8.293600E 01 |
| | | -5.470020E 03 | -4.142660E 02 | 3.082790E 04 | -1.372000E 01 | -5.519260E-01 | 5.326690E 01 |
| | | -2.735550E 03 | -2.074110E 02 | 1.546660E 04 | -6.862950E 00 | -2.754990E-01 | 2.769340E 01 |
| | | -3.312550E 03 | -9.501110E 02 | -1.530010E 04 | -8.255510E 00 | -1.688820E 00 | -2.744880E 01 |
| | | -6.627970E 03 | -1.900120E 03 | -3.059340E 04 | -1.652370E 01 | -3.372090E 00 | -5.490070E 01 |
| | | -9.936600E 03 | -2.850600E 03 | -4.586600E 04 | -2.475100E 01 | -4.751500E 00 | -8.229500E 01 |
| MP2 | 1.670000E-03 | | | | | | |
| | | -1.924000E 04 | 1.603800E 04 | 3.904700E 02 | -6.444400E 01 | 4.654200E 01 | 1.117100E 00 |
| | | -1.299070E 04 | 1.077290E 04 | 2.611360E 02 | -4.266290E 01 | 3.022040E 01 | 7.500440E 00 |
| | | -6.430120E 03 | 5.346270E 03 | 1.300070E 02 | -2.133770E 01 | 1.552090E 01 | 3.720440E-01 |
| | | 1.066660E 04 | -7.899410E 03 | 4.392670E 02 | 3.438550E 01 | -2.742050E 01 | 1.238550E 00 |
| | | 2.122240E 04 | -1.573350E 04 | 8.785050E 02 | 6.872880E 01 | -5.487490E 01 | 2.477570E 00 |
| | | 3.180800E 04 | -2.967500E 04 | 1.307200E 03 | 1.031900E 02 | -8.211000E 01 | 3.709800E 00 |
| MY2 | 1.670000E-03 | | | | | | |
| | | -3.957700E 03 | 7.034800E 02 | -5.871200E 04 | -1.302600E 01 | 2.272800E 00 | -1.622900E 02 |
| | | -2.700490E 03 | 4.780510E 02 | -4.019110E 04 | -8.671030E 00 | 1.552460E 00 | -1.088420E 02 |
| | | -1.320440E 03 | 2.344580E 02 | -2.001040E 04 | -4.332010E 00 | 7.513080E-01 | -5.400100E 01 |
| | | -4.806620E 01 | 8.311610E 01 | 2.844610E 03 | -1.617380E-01 | 2.341080E-01 | 5.044270E 00 |
| | | -9.601130E 01 | 1.662010E 02 | 5.688220E 03 | -3.225080E-01 | 4.688570E-01 | 1.016790E 01 |
| | | -1.448000E 02 | 2.499300E 02 | 5.520500E 03 | -4.846800E-01 | 7.010000E-01 | 1.512300E 01 |
| MP3 | 5.570000E-04 | | | | | | |
| | | -3.265400E 04 | 7.218300E 03 | 3.049800E 02 | -1.651800E 02 | 3.479300E 01 | 1.445000E 00 |
| | | -2.201470E 04 | 4.831950E 03 | 2.050110E 02 | -1.102660E 02 | 2.301960E 01 | 9.730550E-01 |
| | | -1.094560E 04 | 2.413090E 03 | 1.022690E 02 | -5.513920E 01 | 1.152000E 01 | 4.859980E-01 |
| | | 5.062370E 03 | -1.046670E 03 | -4.993050E 01 | 2.666760E 01 | -5.304290E 00 | -2.889150E-01 |
| | | 1.153770E 04 | -2.088870E 03 | -1.009990E 02 | 5.324440E 01 | -1.077840E 01 | -5.700010E-03 |
| | | 1.517400E 04 | -3.126100E 03 | -1.478900E 02 | 7.998600E 01 | -1.578900E 01 | -7.337800E-03 |
| MY3 | 5.570000E-04 | | | | | | |
| | | -6.302100E 02 | -1.183400E 03 | -3.410700E 04 | -3.208500E 00 | -5.699100E 00 | -1.647000E 02 |
| | | -4.203640E 02 | -8.001060E 03 | -2.084880E 04 | -2.143090E 00 | -3.799000E 00 | -1.162340E 01 |
| | | -2.101070E 02 | -3.992960E 03 | -1.152070E 04 | -1.076770E 00 | -1.899420E 00 | -5.830100E 00 |
| | | 6.310040E 01 | 9.083040E 01 | 4.375410E 03 | 3.313320E-01 | 4.020660E-01 | 2.114550E 00 |
| | | 1.274410E 02 | 1.872090E 02 | 8.751440E 03 | 6.622090E-01 | 8.049950E-01 | 4.238510E 01 |
| | | 1.890700E 02 | 2.719300E 02 | 1.305200E 04 | 9.707500E-01 | 1.315600E 00 | 6.321300E 01 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| W4CP | 3.000000E-02 | | | | | | |
| | | -1.191700E 04 | -6.354600E 03 | -9.528200E 04 | -7.913100E 01 | -4.116700E 01 | -6.216500E 02 |
| | | -7.946580E 03 | -4.357520E 03 | -6.049710E 04 | -5.264980E 01 | -2.745090E 01 | -4.149010E 02 |
| | | -3.973290E 03 | -2.118260E 03 | -3.176140E 04 | -2.637740E 01 | -1.372210E 01 | -2.072220E 02 |
| | | 3.995210E 03 | -1.101320E 03 | 3.405210E 04 | 2.657530E 01 | -7.108290E 00 | 2.221250E 02 |
| | | 7.982670E 03 | -2.202640E 03 | 6.806270E 04 | 5.319080E 01 | -1.420610E 01 | 4.440590E 02 |
| | | 1.198500E 04 | -3.303800E 03 | 1.021400E 05 | 7.972600E 01 | -2.132400E 01 | 6.663700E 02 |
| W4CY | 3.000000E-02 | | | | | | |
| | | 9.638700E 04 | -1.229500E 04 | -1.107700E 04 | 6.499300E 02 | -8.093200E 01 | -7.112100E 01 |
| | | 6.424990E 04 | -8.104270E 03 | -7.385010E 03 | 4.329050E 02 | -5.388010E 01 | -4.749010E 01 |
| | | 3.212940E 04 | -4.098130E 03 | -3.692440E 03 | 2.166430E 02 | -2.697740E 01 | -2.370590E 01 |
| | | -3.462090E 04 | 1.015990E 03 | 4.041000E 03 | -2.330920E 02 | 7.064440E 00 | 2.594110E 01 |
| | | -6.925040E 04 | 2.023050E 03 | 8.089010E 03 | -4.666020E 02 | 1.412050E 01 | 5.180110E 01 |
| | | -1.038000E 05 | 3.047600E 03 | 1.212200E 04 | -6.999200E 02 | 2.119200E 01 | 7.782500E 01 |

TABLE 10. DATA FROM CROSS TERM CARDS

```
CODE1 CODE2 STND.DEV.1  STND.DEV.2
                     6 CROSS TERMS
TMP2      KRP2      1.670000E-03  4.400000E-02
-3.928431E 07  3.118537E 07 -5.178885E 05 -1.296294E 05  9.735257E 04 -1.473889E 03
TMP2      DPB2      1.670000E-03  1.000000E-01
-2.340326E 07  1.922848E 07  7.669614E 05 -7.720792E 04  5.836906E 04  2.226114E 03
ROE2      TMP2      2.500000E-01  1.670000E-03
-8.148860E 06  6.520423E 06 -3.372101E 05 -2.693384E 04  2.011619E 04 -9.675449E 02
TMY2      KRY2      1.670000E-03  2.620000E-02
 6.064416E 05 -2.690189E 07 -1.574909E 08  3.320707E 03 -2.136188E 04 -4.285980E 05
TMY2      DYB2      1.670000E-03  1.000000E-01
-1.649723E 06 -9.353201E 05 -5.284571E 07 -5.343820E 03 -2.494017E 03 -1.442783E 05
ROE2      TMY2      2.500000E-01  1.670000E-03
-2.014488E 05 -5.892312E 05 -1.625653E 07 -6.295840E 02 -1.623342E 03 -4.419861E 04
ROE3      TMY3      2.500000E-01  5.570000E-04
-2.006235E 05 -1.117907E 06 -3.070665E 07 -1.017385E 03 -5.363077E 03 -1.482963E 05
DYB3      TMY3      1.000000E-01  5.570000E-04
-1.659506E 06 -3.114164E 06 -8.952605E 07 -8.477071E 03 -1.495644E 04 -4.329054E 05
TMY3      KRY3      5.570000E-04  4.400000E-02
-3.131179E 06 -5.746561E 06 -1.739315E 08 -1.599095E 04 -2.752418E 04 -8.401587E 05
ROE3      TMP3      2.500000E-01  5.570000E-04
-3.009858E 07  6.585904E 06 -5.495271E 04 -1.530964E 05  3.195147E 04 -2.254019E 02
DPB3      TMP3      1.000000E-01  5.570000E-04
-9.540070E 07  2.061374E 07  9.043896E 05 -4.841963E 05  9.980111E 04  4.384070E 03
TMP3      KRP3      5.570000E-04  4.400000E-02
-1.659339E 08  3.631318E 07  1.562803E 06 -8.451101E 05  1.764244E 05  7.652079E 03
```

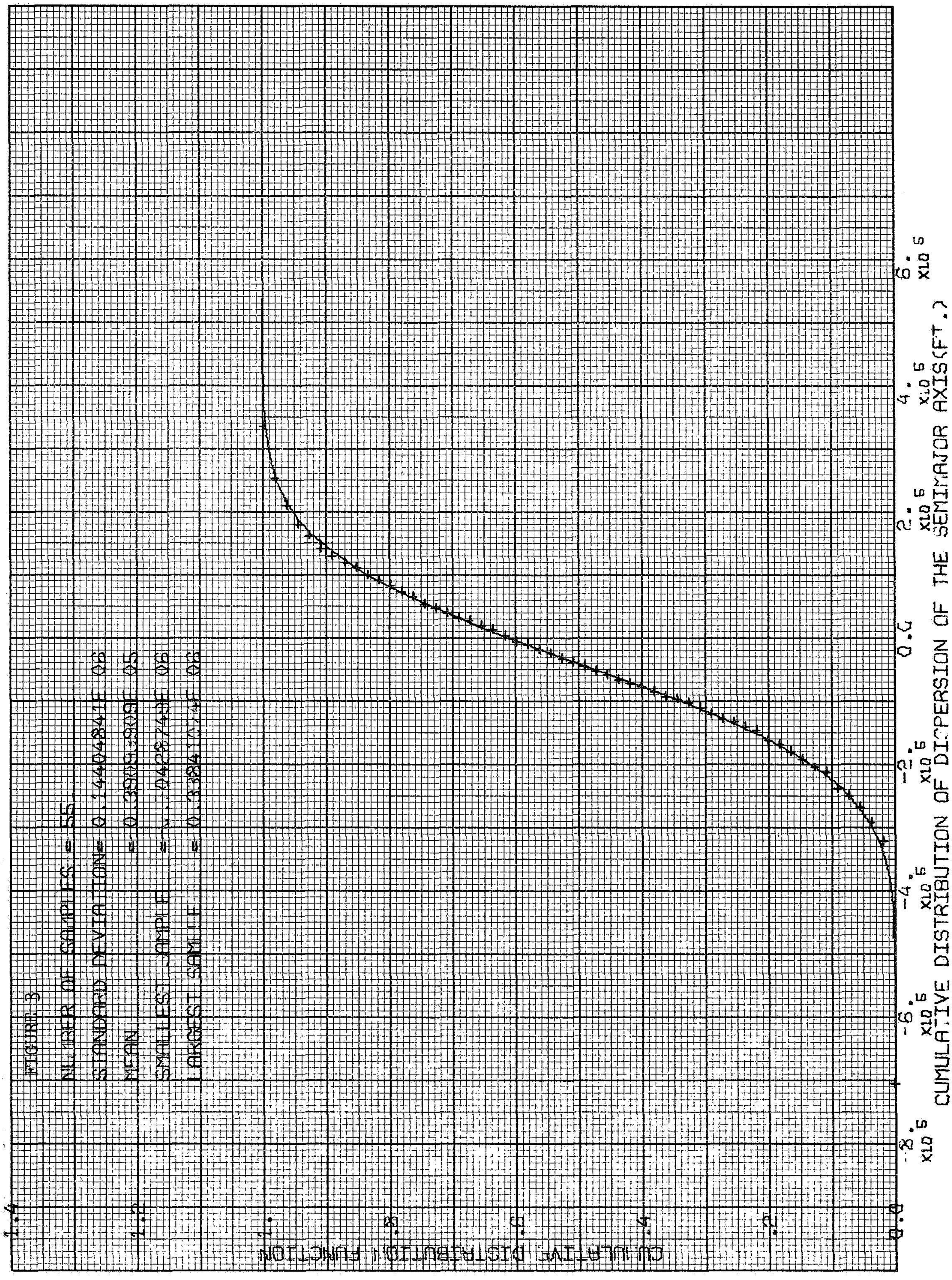
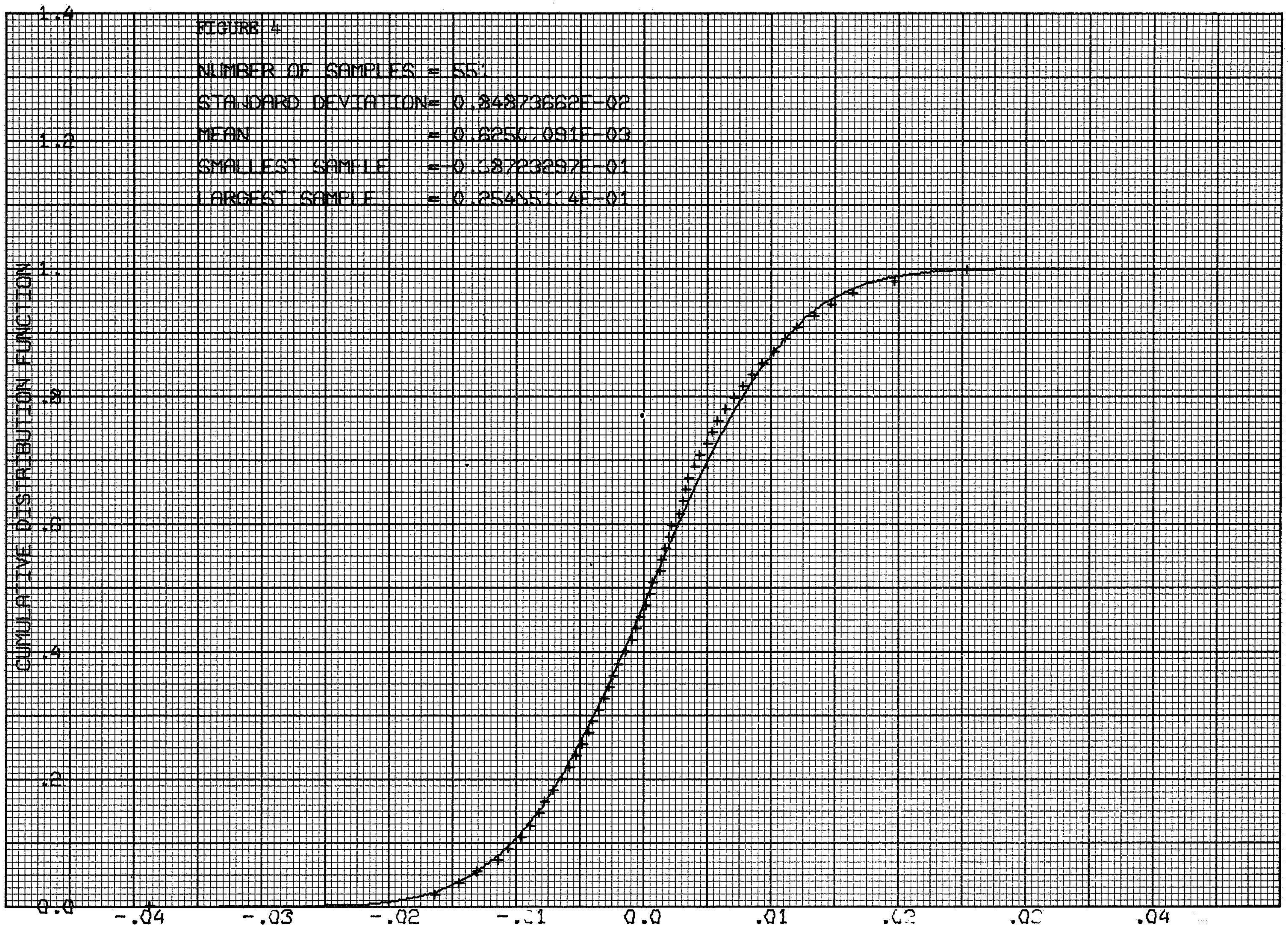


FIGURE 3
NUMBER OF SAMPLES = 55
STANDARD DEVIATION= 0.14404841E 06
MEAN = 0.39069909E 05
SMALLEST SAMPLE = -.04287439E 06
LARGEST SAMPLE = 0.33841074E 06
CUMULATIVE DISTRIBUTION FUNCTION
CUMULATIVE DISTRIBUTION OF DISPERSION OF THE SEMIMAJOR AXIS(FT.)
0.0
.2
.4
.6
.8
1.
1.2
1.4
-8. X10 5
-6. X10 5
-4. X10 5
-2. X10 5
0.0
2. X10 5
4. X10 5
6. X10 5




CUMULATIVE DISTRIBUTION OF ECCENTRICITY DISPERSION

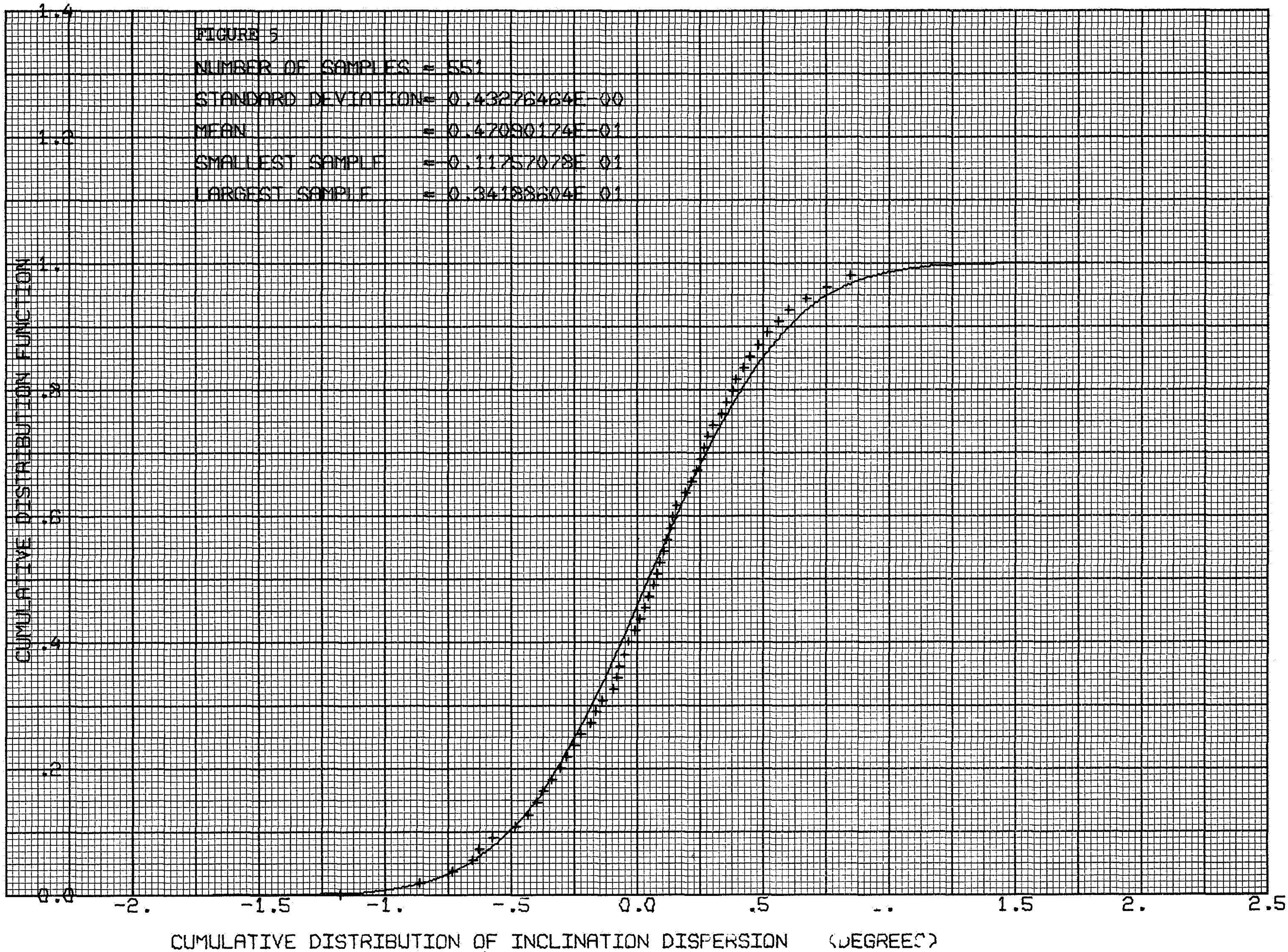


FIGURE 5
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.43276464E-00
MEAN = 0.47090174E-01
SMALLEST SAMPLE =-0.11757078E 01
LARGEST SAMPLE = 0.34188604E 01
CUMULATIVE DISTRIBUTION FUNCTION
0.0
.2
.4
.6
.8
1.
1.2
1.4
-2.
-1.5
-1.
-.5
0.0
.5
1.5
2.
2.5
CUMULATIVE DISTRIBUTION OF INCLINATION DISPERSION (DEGREES)

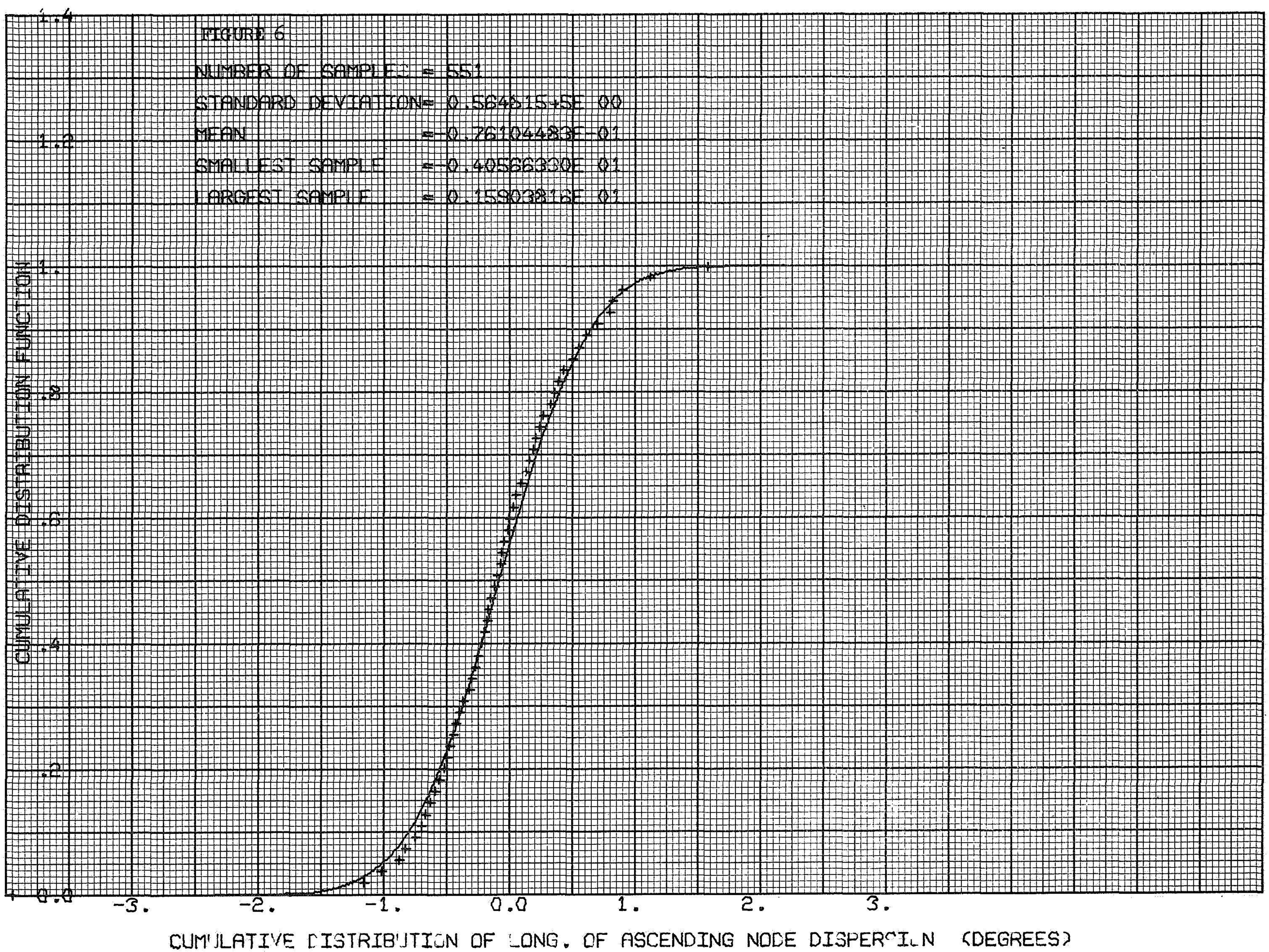


FIGURE 6
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.564615+5E 00
MEAN = -0.76104483E-01
SMALLEST SAMPLE = -0.40566330E 01
LARGEST SAMPLE = 0.15903816E 01
CUMULATIVE DISTRIBUTION FUNCTION
1.4
1.2
1.
.8
.6
.4
.2
0.0
-3.
-2.
-1.
0.0
1.
2.
3.
CUMULATIVE DISTRIBUTION OF LONG. OF ASCENDING NODE DISPERSION (DEGREES)

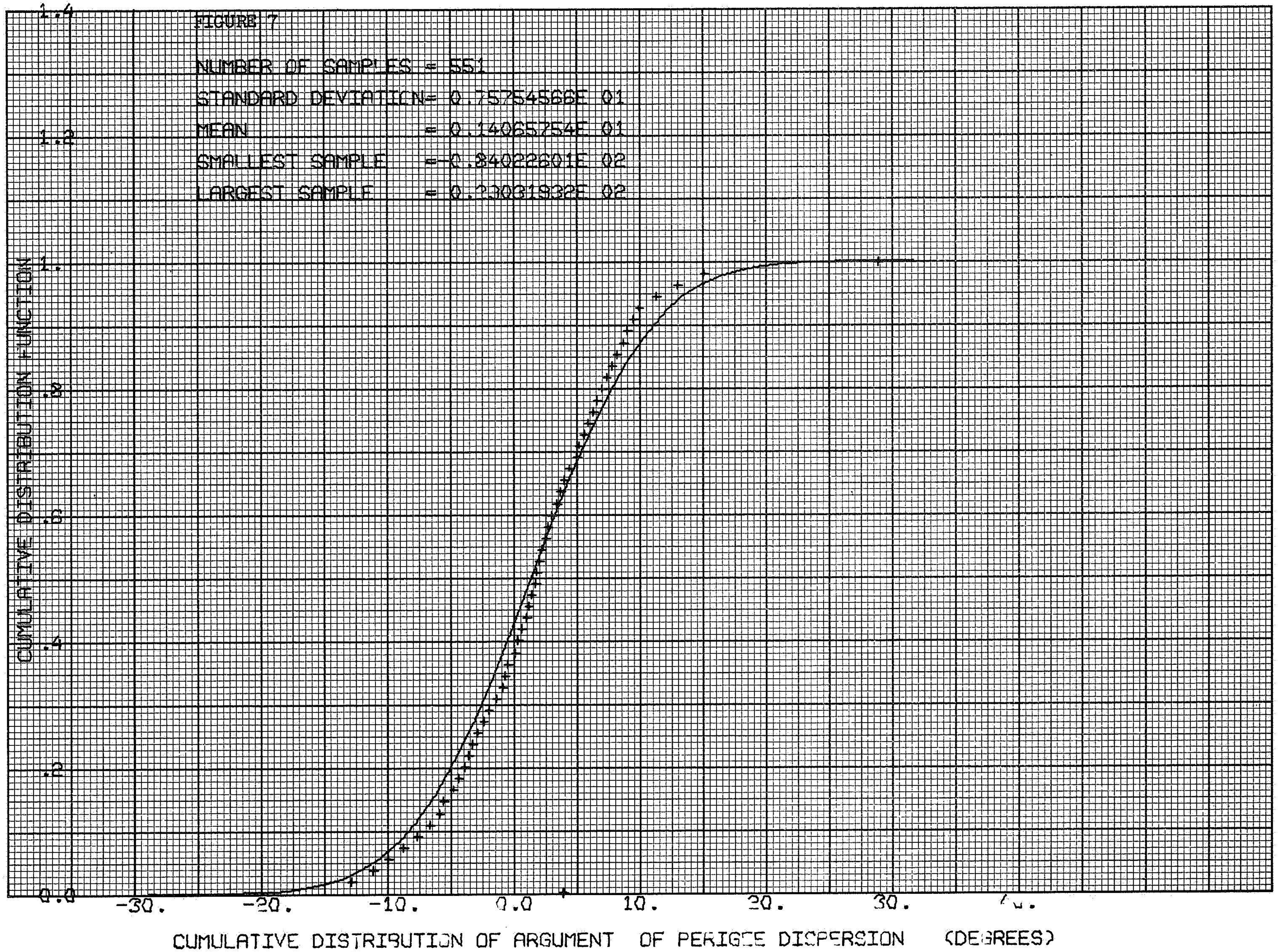


FIGURE 7
NUMBER OF SAMPLES = 551
STANDARD DEVIATICN= 0.75754566E 01
MEAN = 0.14065754E 01
SMALLEST SAMPLE =-0.84022601E 02
LARGEST SAMPLE = 0.23031932E 02
CUMULATIVE DISTRIBUTION FUNCTION
1.4
1.2
1.
.8
.6
.4
.2
0.0
-30.
-20.
-10.
0.0
10.
20.
30.
CUMULATIVE DISTRIBUTION OF ARGUMENT OF PERIGEE DISPERSION (DEGREES)

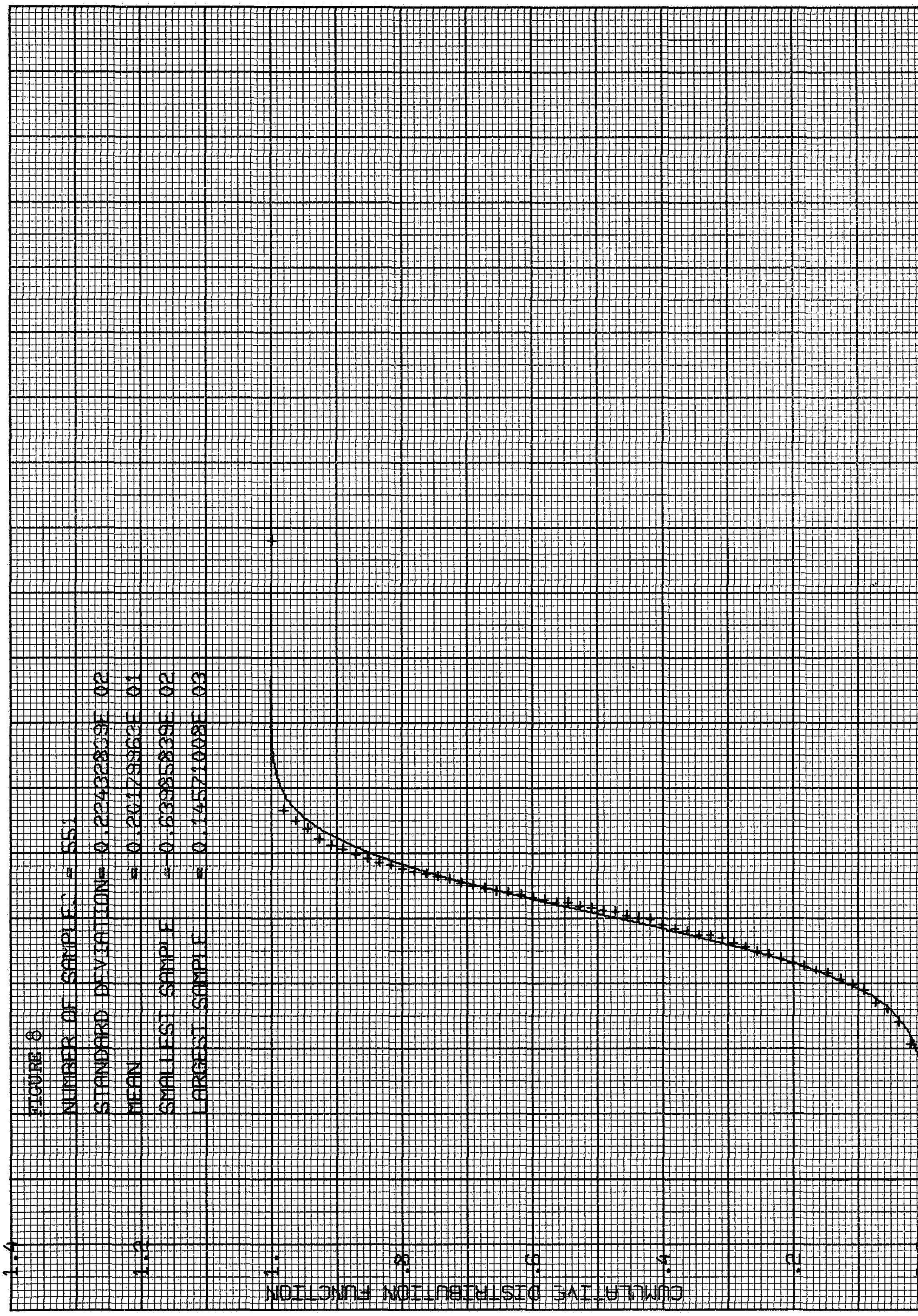


FIGURE 8
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.22432839E 02
MEAN = 0.20172986E 01
SMALLEST SAMPLE = -0.63985839E 02
LARGEST SAMPLE = 0.14571008E 03
1.4
1.2
1.
.8
.6
.4
.2
0.0
CUMULATIVE DISTRIBUTION FUNCTION
-100.
-50.
0.0
50.
100.
150.
CUMULATIVE DISTRIBUTION OF DISPERSION OF ARC LENGTH ALONG ORBIT (NM)

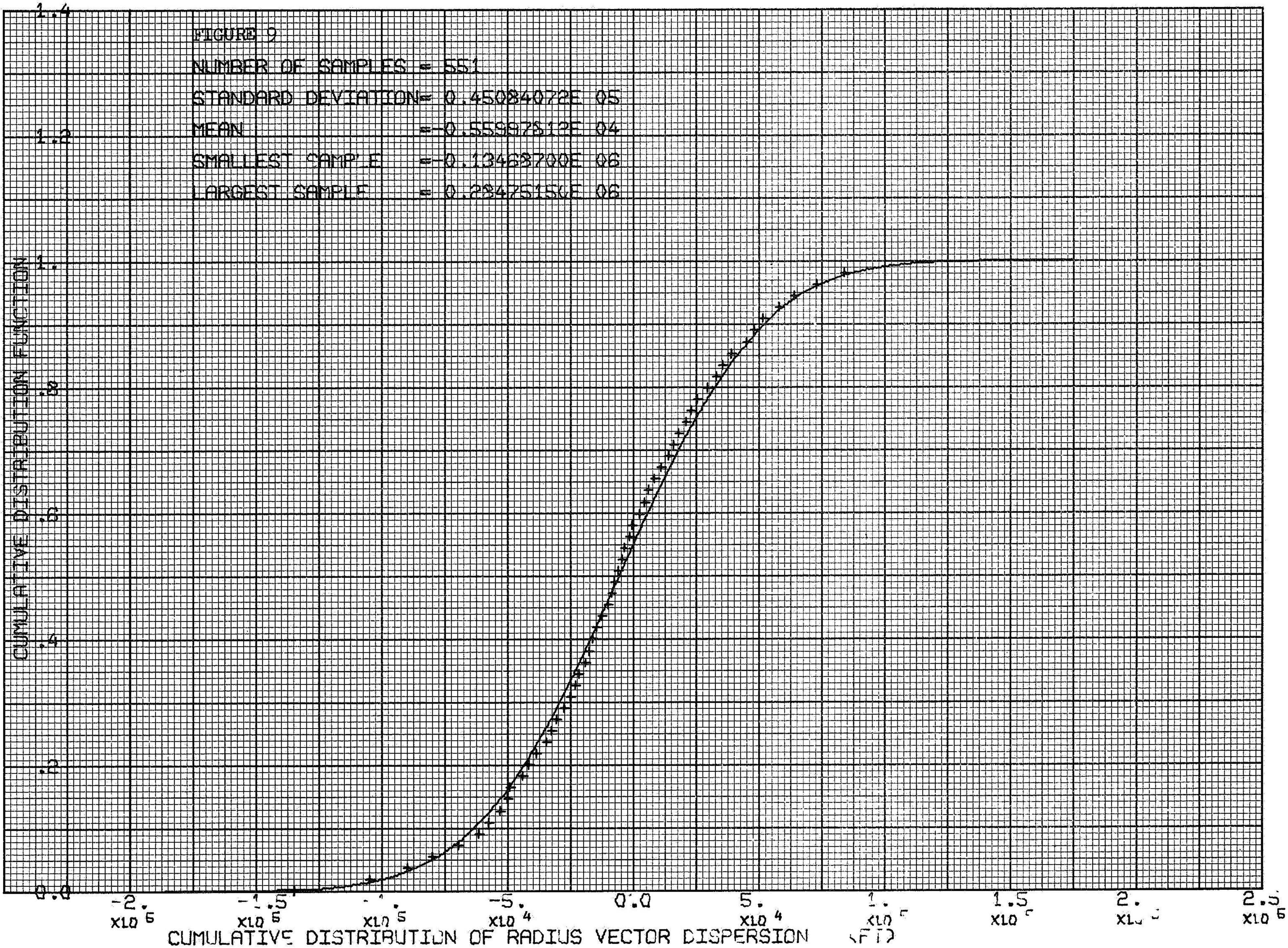


FIGURE 9
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.45084072E 05
MEAN =-0.55987812E 04
SMALLEST SAMPLE =-0.13468700E 06
LARGEST SAMPLE = 0.28475156E 06
CUMULATIVE DISTRIBUTION FUNCTION
CUMULATIVE DISTRIBUTION OF RADIUS VECTOR DISPERSION (FT)

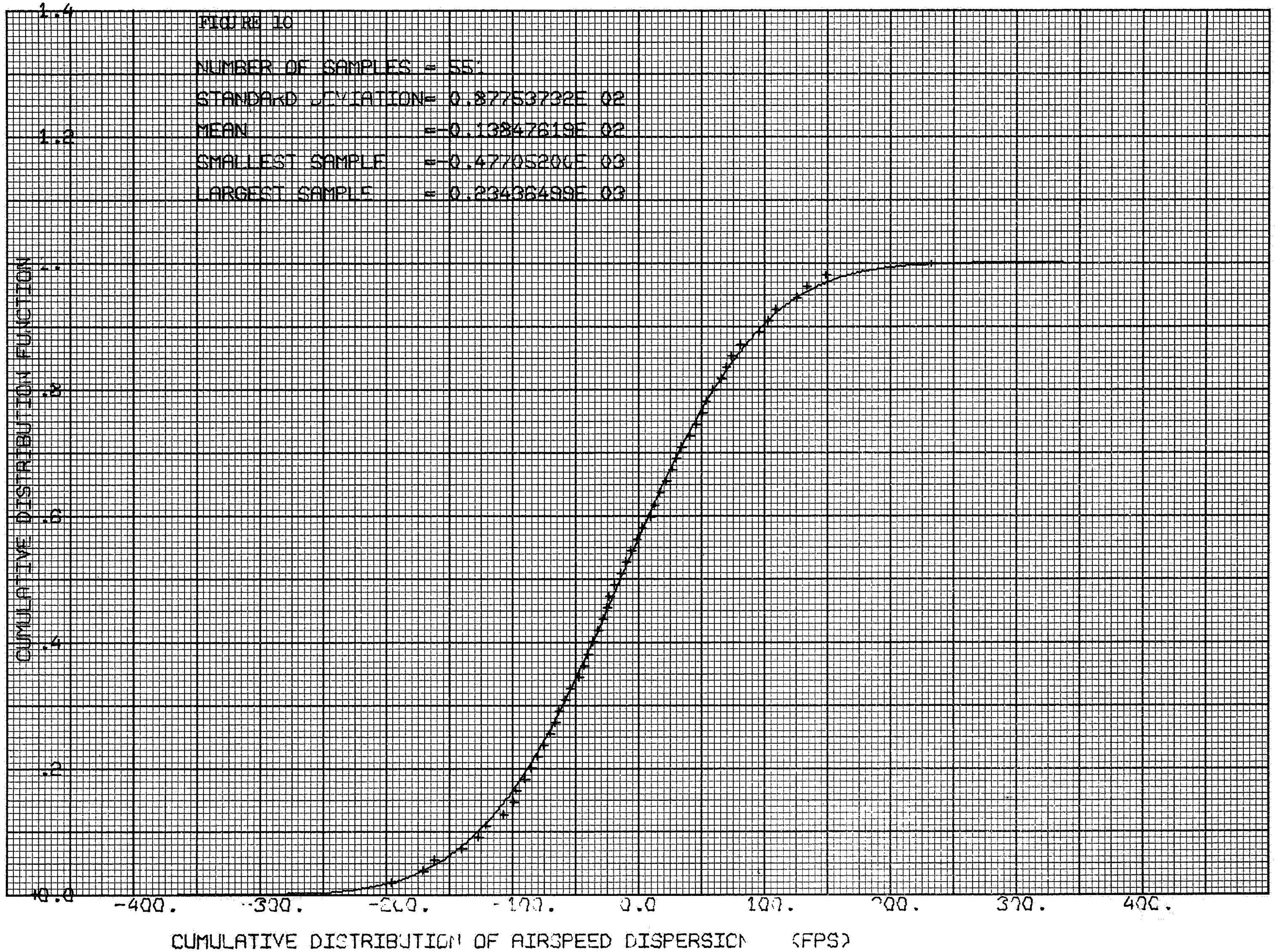


FIGURE 10
NUMBER OF SAMPLES = 55.
STANDARD DEVIATION= 0.37753732E 02
MEAN = -0.13847619E 02
SMALLEST SAMPLE = -0.47705200E 03
LARGEST SAMPLE = 0.23436499E 03
CUMULATIVE DISTRIBUTION FUNCTION
CUMULATIVE DISTRIBUTION OF AIRSPEED DISPERSION (FPS)

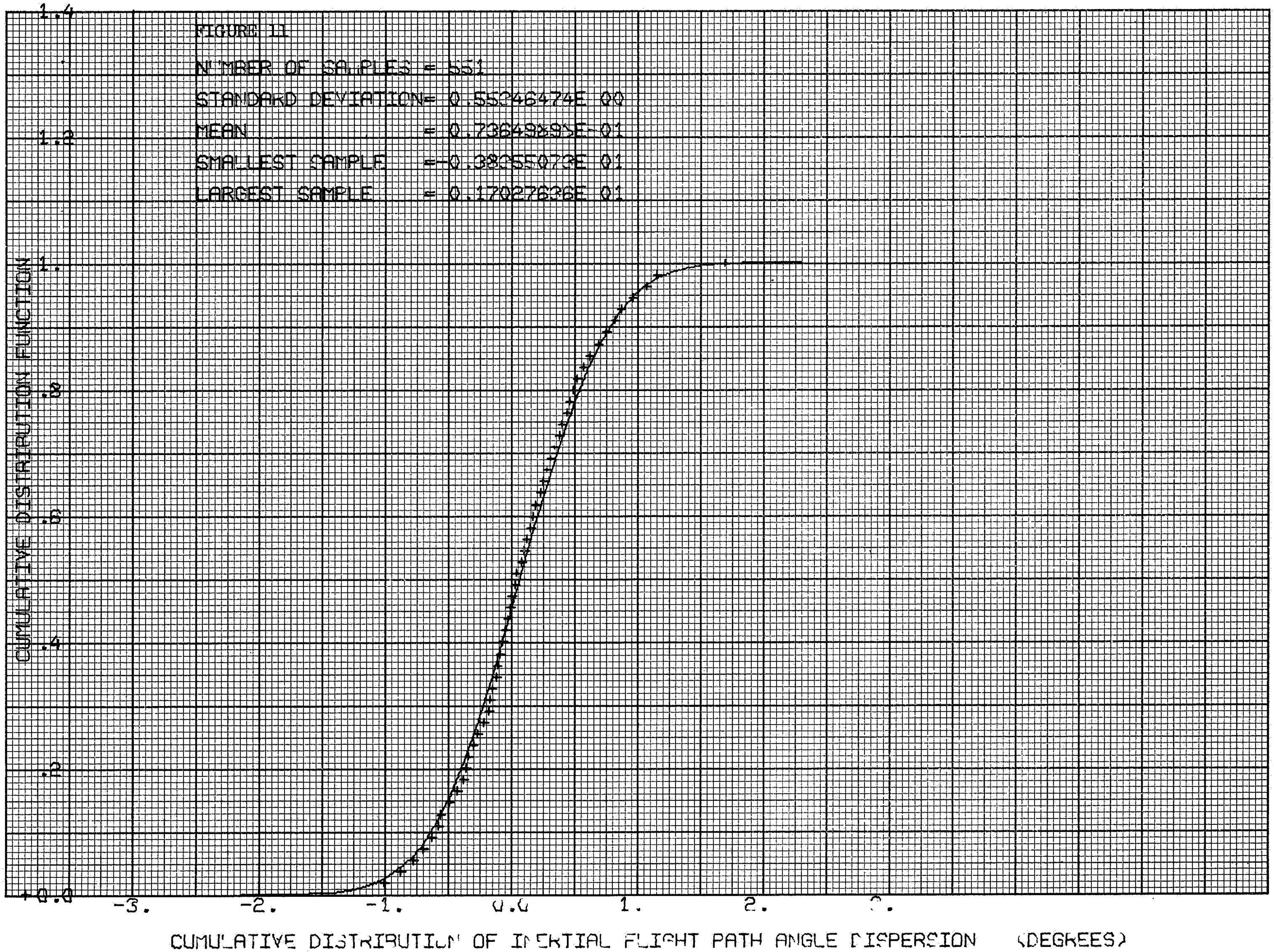


FIGURE 11
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.55246474E 00
MEAN = 0.73649895E-01
SMALLEST SAMPLE = -0.38055073E 01
LARGEST SAMPLE = 0.17027636E 01
CUMULATIVE DISTRIBUTION FUNCTION
1.4
1.2
1.
.8
.6
.4
.2
0.0
-3.
-2.
-1.
0.0
1.
2.
3.
CUMULATIVE DISTRIBUTION OF INERTIAL FLIGHT PATH ANGLE DISPERSION (DEGREES)

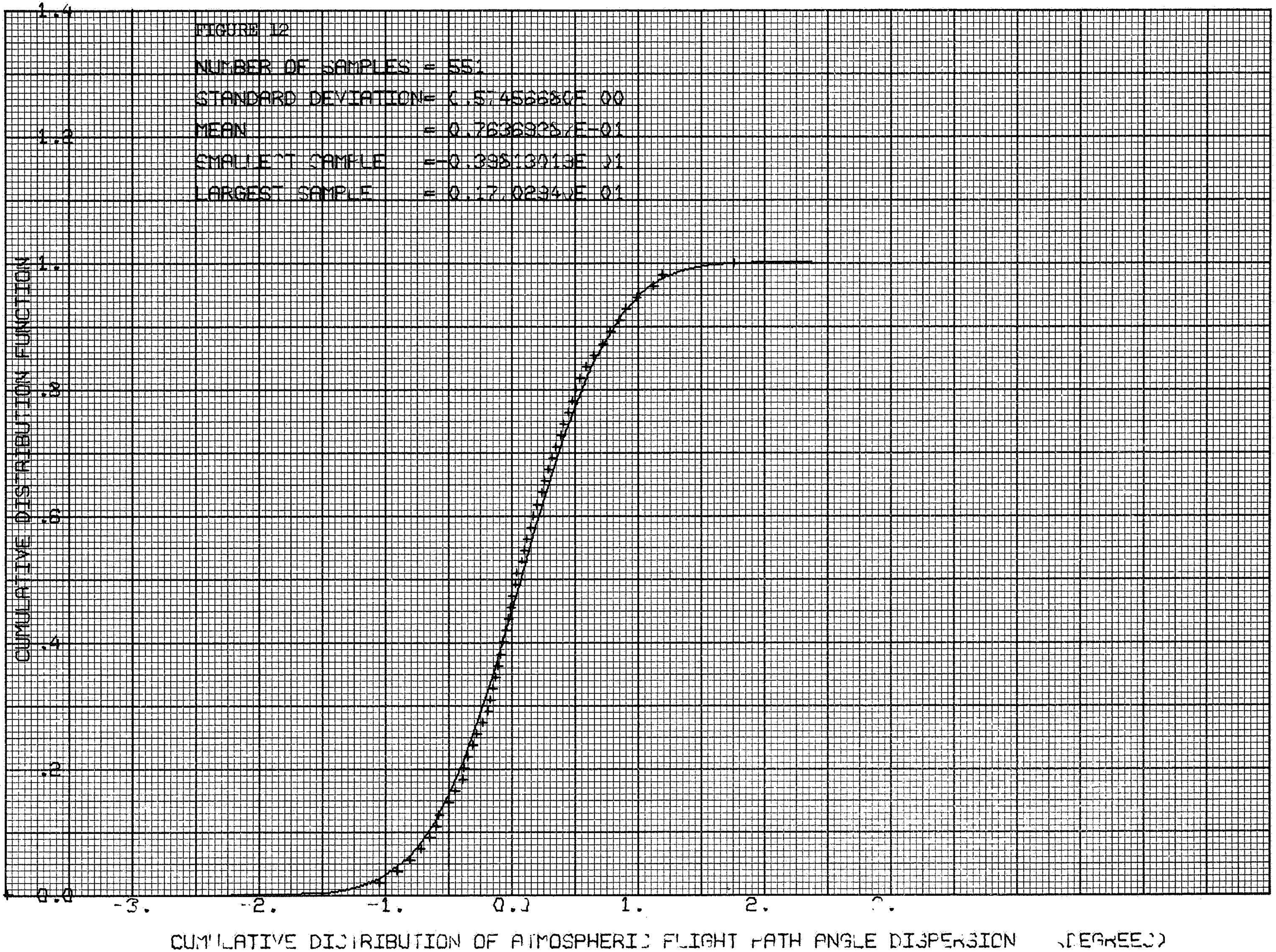


FIGURE 12
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.57456680E 00
MEAN = 0.76369325E-01
SMALLEST SAMPLE = -0.39813013E 01
LARGEST SAMPLE = 0.17.0234 E 01
CUMULATIVE DISTRIBUTION FUNCTION
CUMULATIVE DISTRIBUTION OF ATMOSPHERIC FLIGHT PATH ANGLE DISPERSION (DEGREES)
0.0
.2
.4
.6
.8
1.
1.2
1.4
-3.
-2.
-1.
0.0
1.
2.

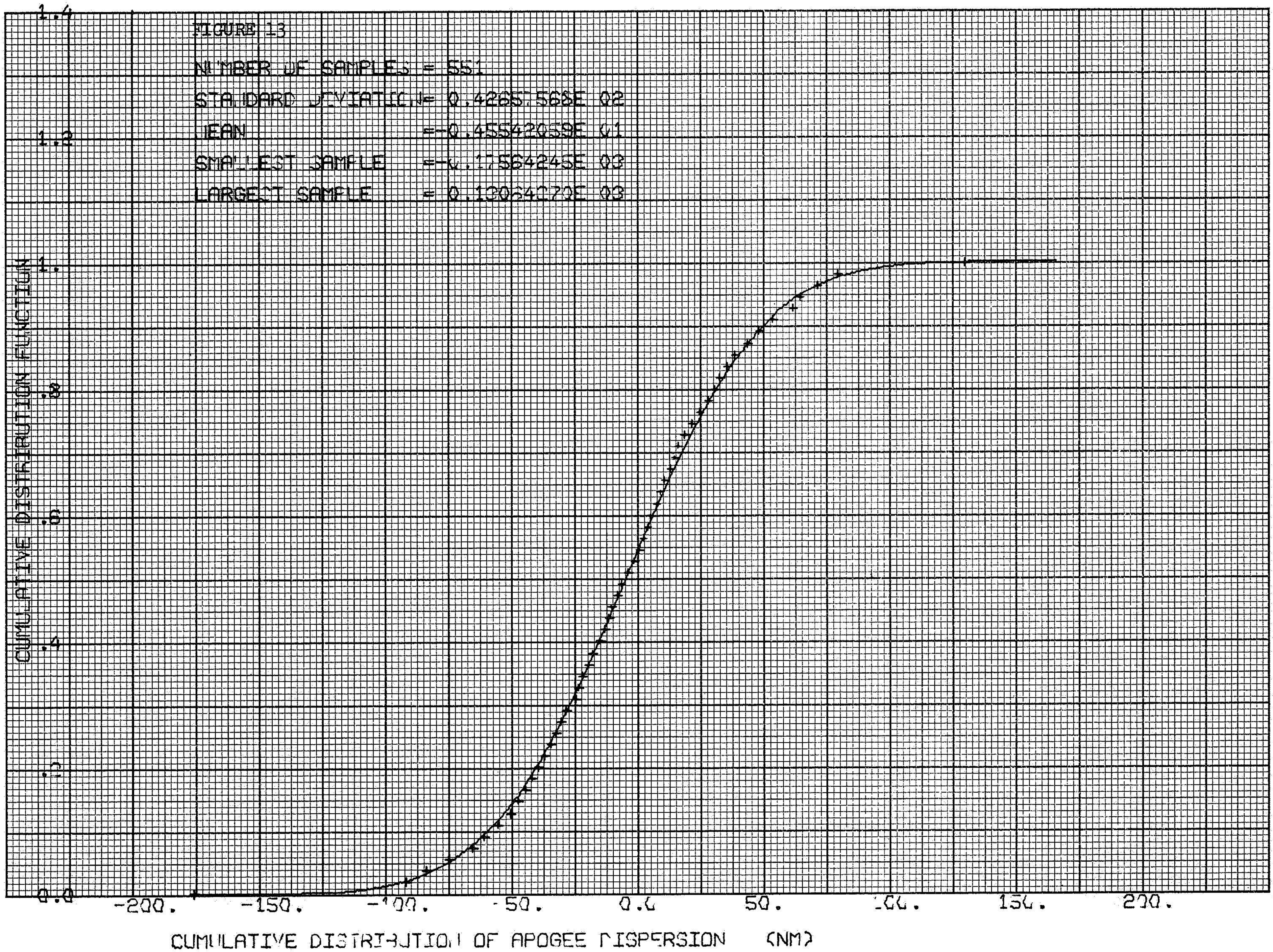


FIGURE 13
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.42657568E 02
MEAN =-0.45542059E 01
SMALLEST SAMPLE =-0.17564245E 03
LARGEST SAMPLE = 0.13064272E 03
CUMULATIVE DISTRIBUTION FUNCTION
1.4
1.2
1.
.8
.6
.4
.2
0.0
-200.
-150.
-100.
-50.
0.0
50.
100.
150.
200.
CUMULATIVE DISTRIBUTION OF APOGEE DISPERSION (NM)

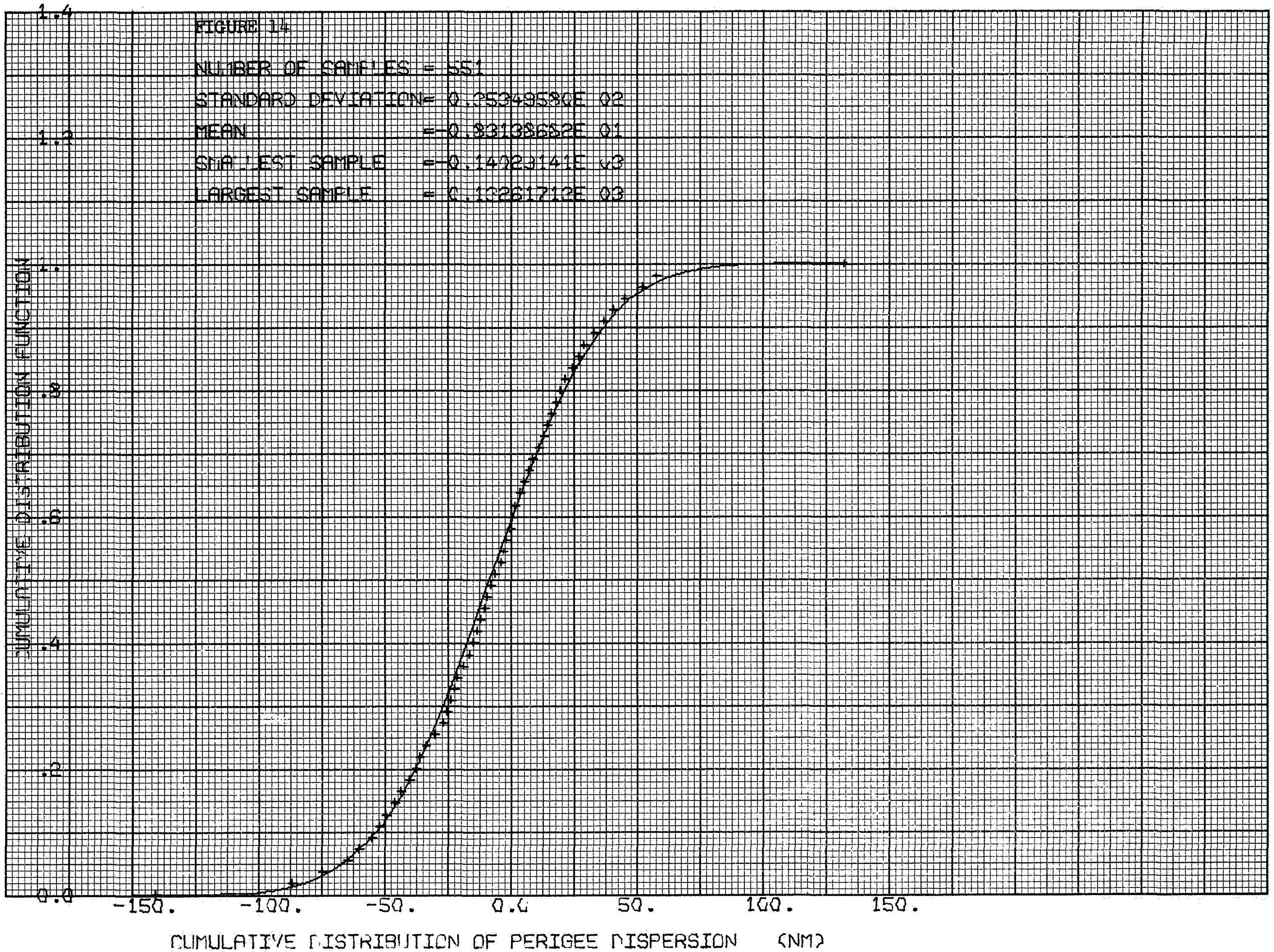


FIGURE 14
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.25349580E 02
MEAN = -0.83138682E 01
SMALLEST SAMPLE = -0.14023141E 03
LARGEST SAMPLE = 0.13261712E 03
CUMULATIVE DISTRIBUTION FUNCTION
1.4
1.2
1.
.8
.6
.4
.2
0.0
-150.
-100.
-50.
0.0
50.
100.
150.
CUMULATIVE DISTRIBUTION OF PERIGEE DISPERSION (NM)

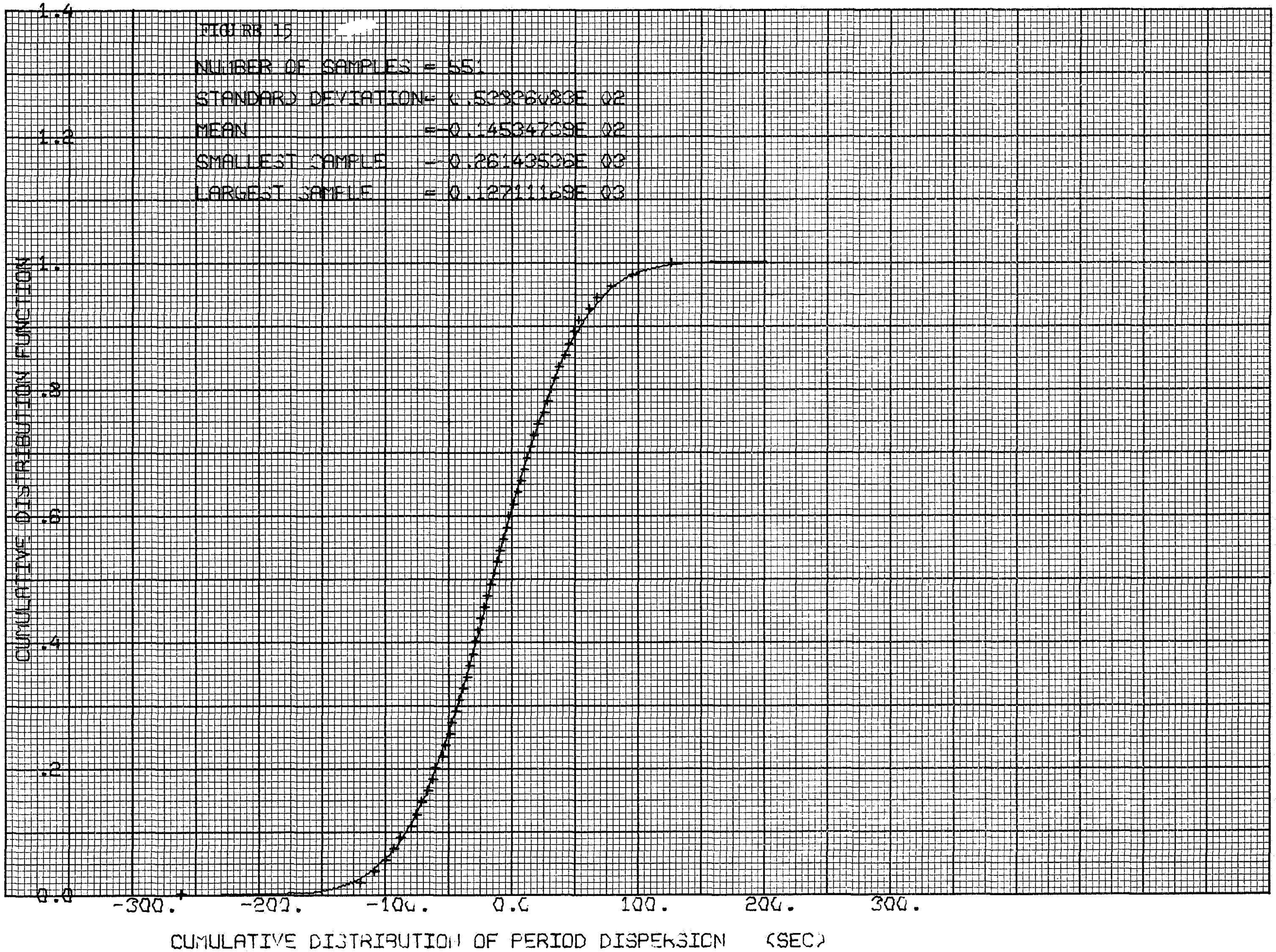


FIGURE 15
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.52926083E 02
MEAN =-0.14534739E 02
SMALLEST SAMPLE =-0.26143536E 03
LARGEST SAMPLE = 0.12711169E 03
CUMULATIVE DISTRIBUTION FUNCTION
1.4
1.2
1.
.8
.6
.4
.2
0.0
-300.
-200.
-100.
0.0
100.
200.
300.
CUMULATIVE DISTRIBUTION OF PERIOD DISPERSION (SEC)

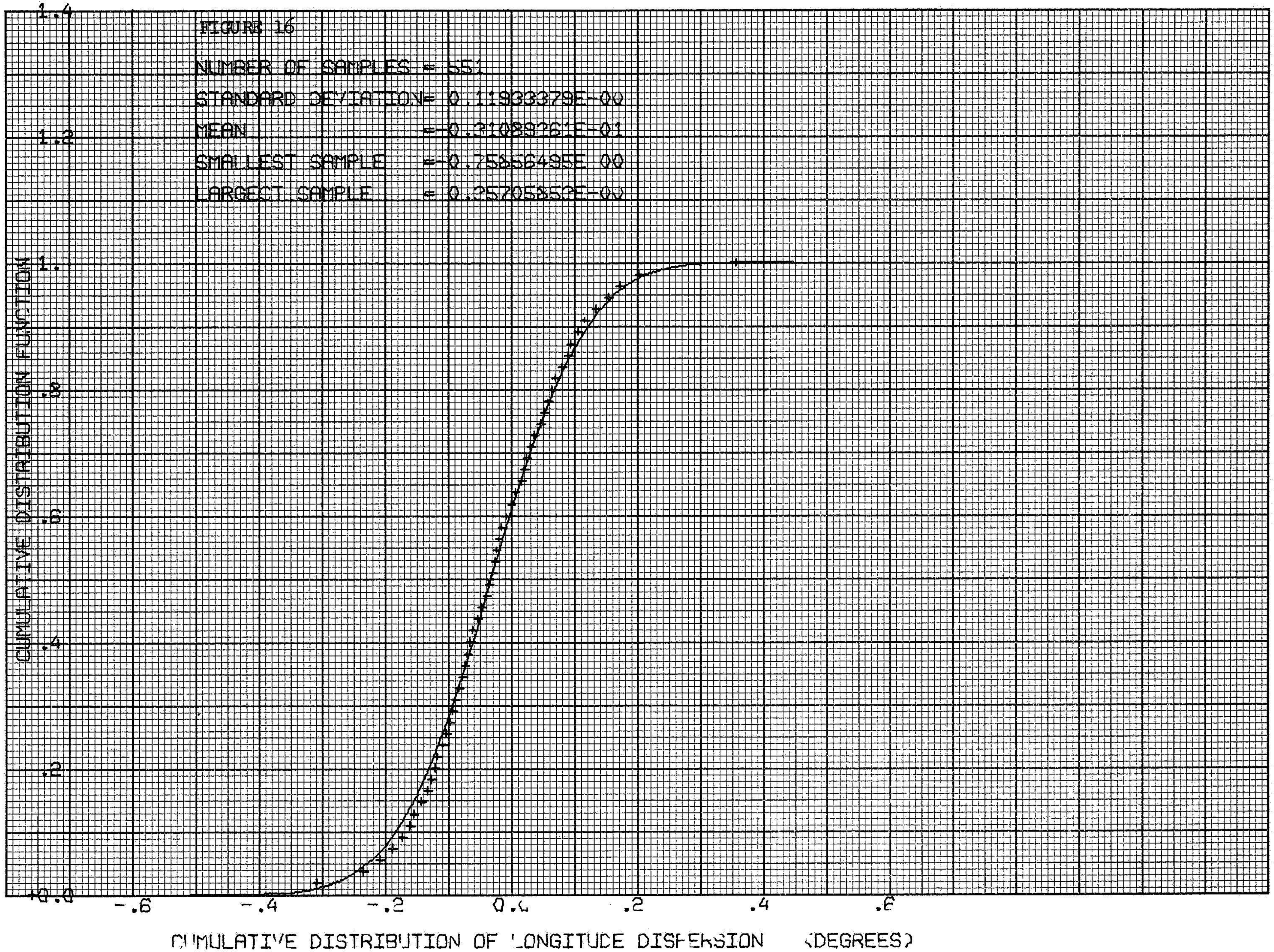


FIGURE 16
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.11933379E-00
MEAN = -0.31089261E-01
SMALLEST SAMPLE = -0.75856495E 00
LARGEST SAMPLE = 0.35705852E-00
1.4
1.2
1.
.8
.6
.4
.2
0.0
-.6
-.4
-.2
0.0
.2
.4
.6
CUMULATIVE DISTRIBUTION FUNCTION
CUMULATIVE DISTRIBUTION OF LONGITUDE DISPERSION (DEGREES)

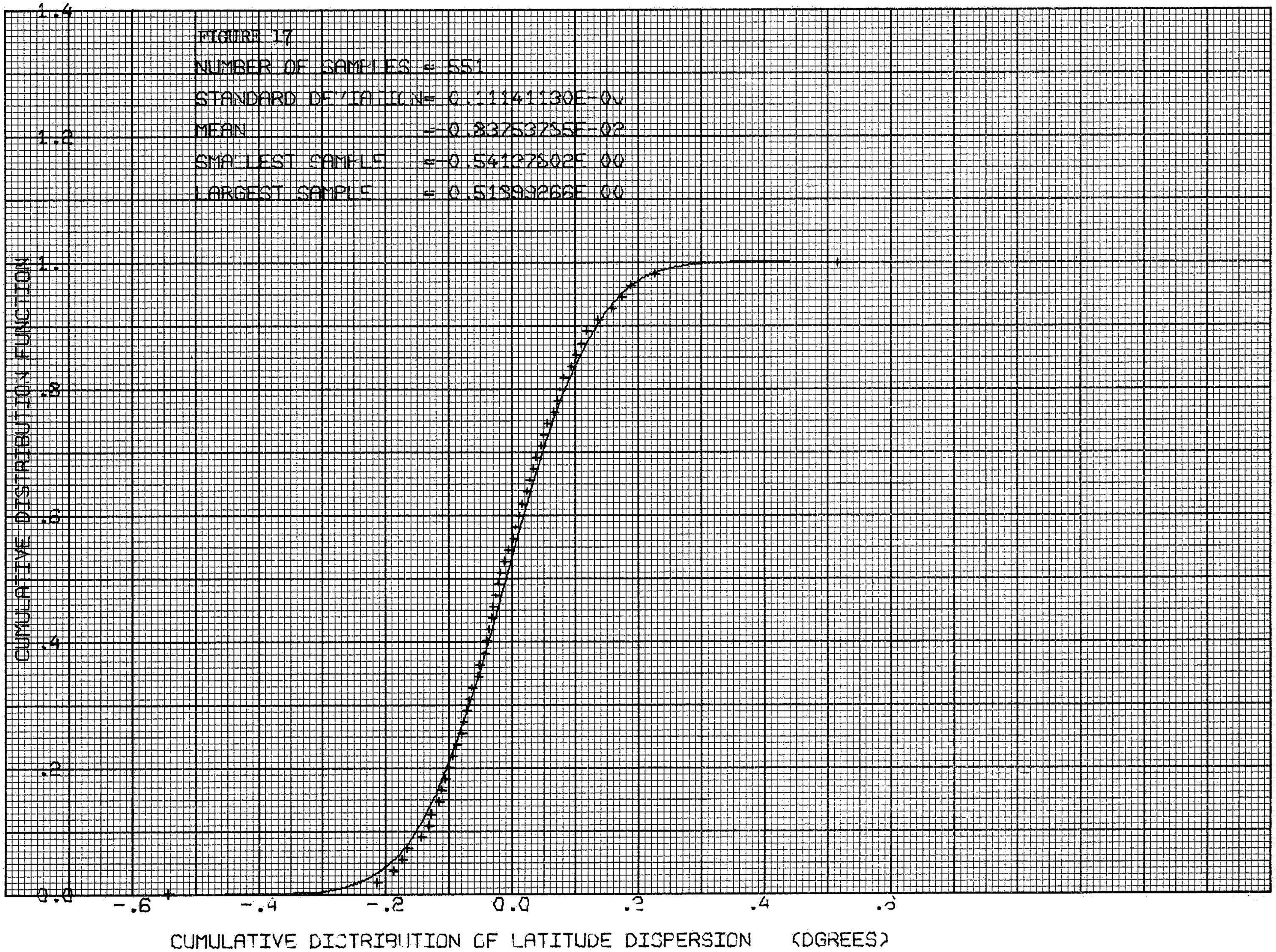


FIGURE 17
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.11141130E-00
MEAN = -0.83753755E-02
SMALLEST SAMPLE = -0.54127802E 00
LARGEST SAMPLE = 0.51399266E 00
CUMULATIVE DISTRIBUTION FUNCTION
0.0
.2
.4
.6
.8
1.
1.2
1.4
-.6
-.4
-.2
0.0
.2
.4
.6
CUMULATIVE DISTRIBUTION OF LATITUDE DISPERSION (DGREES)

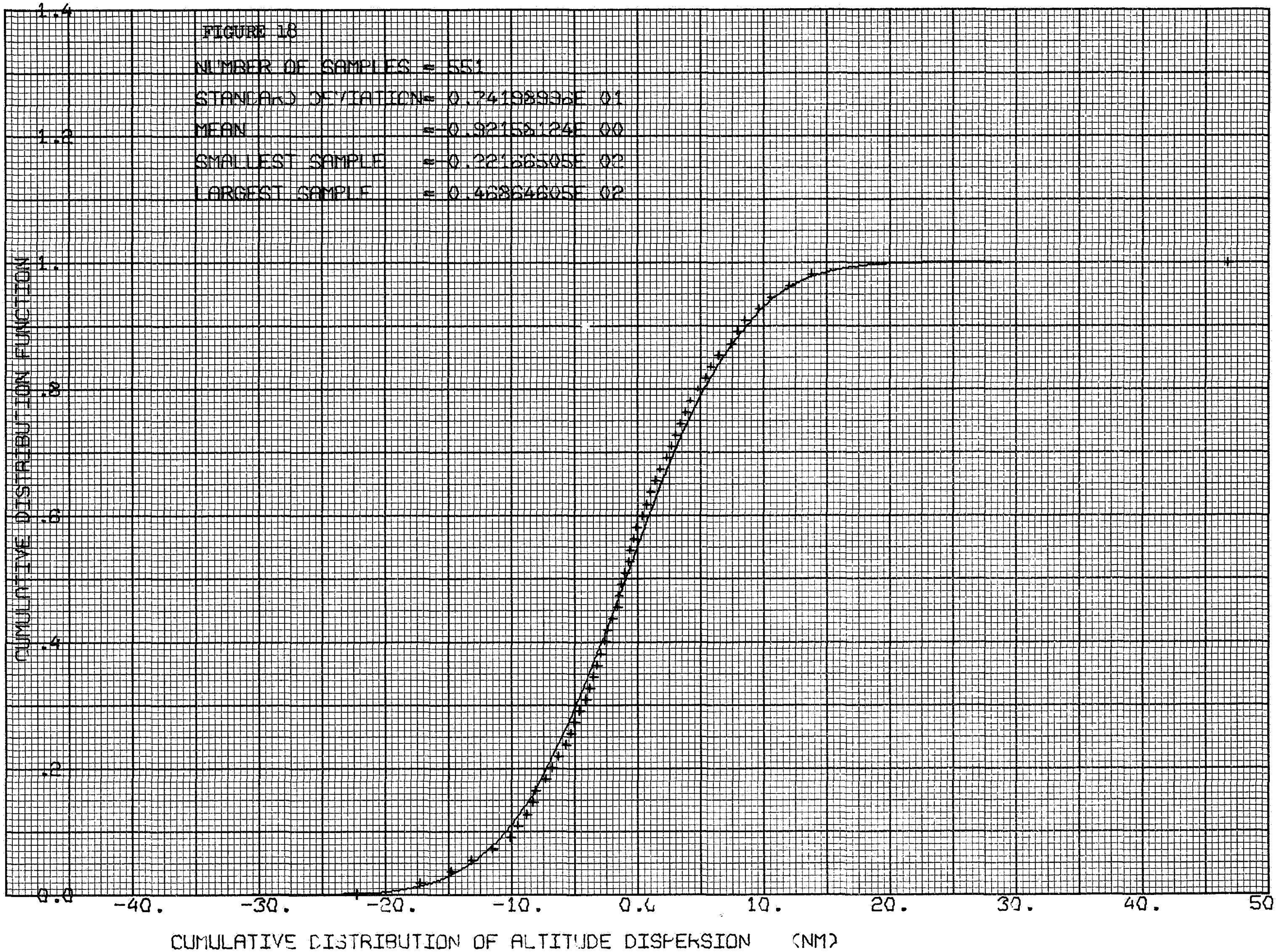


FIGURE 18
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.74198936E 01
MEAN = -0.92156124E 00
SMALLEST SAMPLE = -0.22166505E 02
LARGEST SAMPLE = 0.46864605E 02
CUMULATIVE DISTRIBUTION FUNCTION
0.0
.2
.4
.6
.8
1.
1.2
1.4
-40.
-30.
-20.
-10.
0.0
10.
20.
30.
40.
50.
CUMULATIVE DISTRIBUTION OF ALTITUDE DISPERSION (NM)

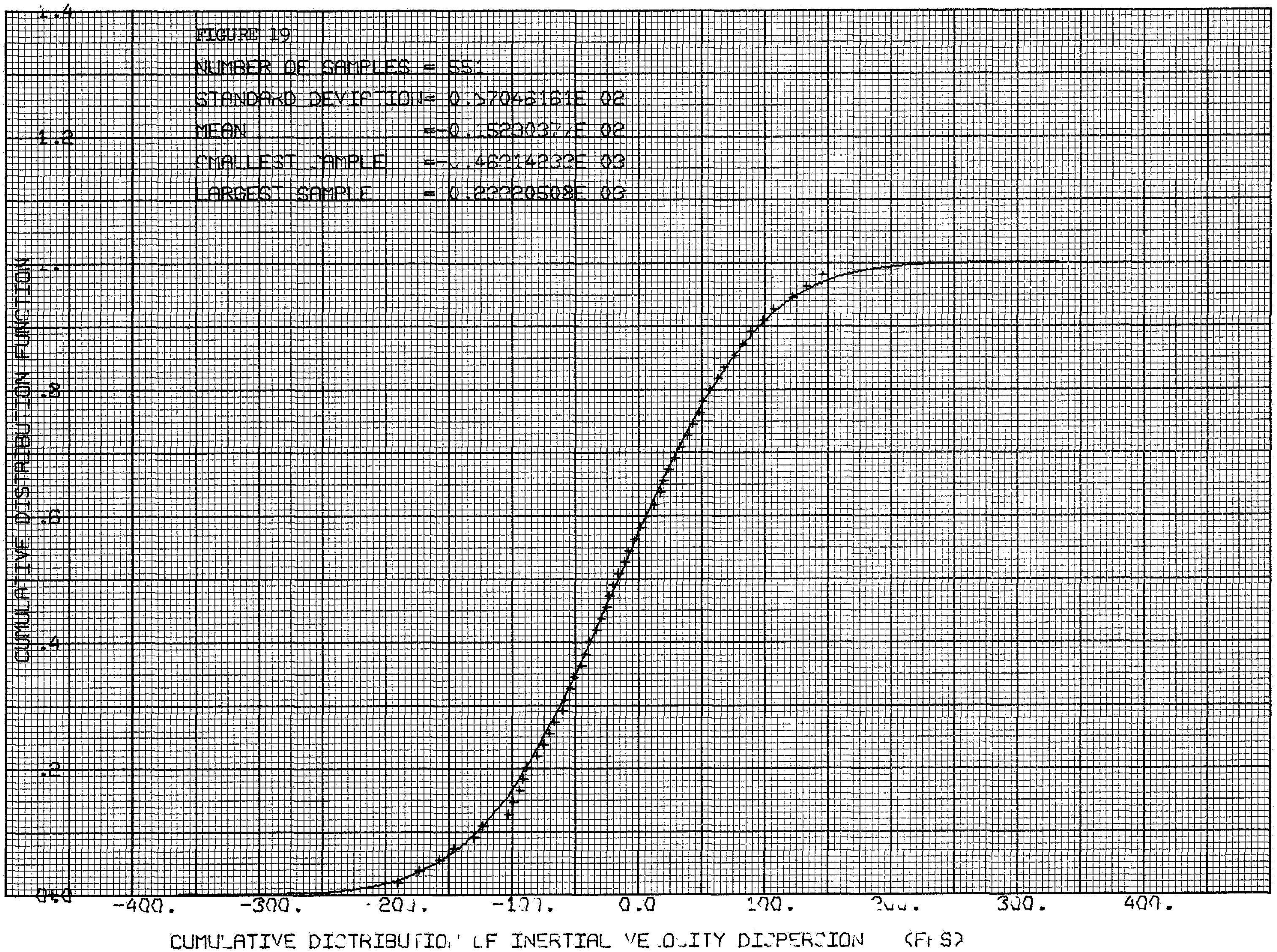


FIGURE 19
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.57046161E 02
MEAN =-0.15230377E 02
SMALLEST SAMPLE =-0.46214233E 03
LARGEST SAMPLE = 0.22220508E 03
CUMULATIVE DISTRIBUTION FUNCTION
1.4
1.2
1.
.8
.6
.4
.2
0.0
-400.
-300.
-200.
-100.
0.0
100.
200.
300.
400.
CUMULATIVE DISTRIBUTION OF INERTIAL VELOCITY DISPERSION (FPS)

## ESCAPE MISSION ERROR ANALYSIS RESULTS

The input data and the resulting nominal trajectory are listed in Table 11. In Table 12 are listed the means, standard deviations and the extreme values for each of the output variables.

Table 13 lists the most significant error sources and their respective three sigma contributions to altitude, velocity, flight path angle and inclination.

Tables 14, 15, 16, 17 and 18 are the individual three sigma contributions of each error source to altitude, velocity, flight path angle and inclination measured at each stage ignition and fifth stage burnout.

Tables 19 and 20 lists the non-linear and cross-term data in this analysis in the same format as previously discussed.

Figures 20-36 depict the cumulative distribution functions for the output variables.

The results of the Monte Carlo analysis show that significant individual contributions are present in all of the stages with no signle source predominating, leading to a total velocity dispersion of 78 ft/sec. The inclination variation is less than in the four stage mission due to the decreased sensitivity caused by a large nominal velocity.

In general, the five burn trajectory was less sensitive to errors in first and second stage than was the four stage mission. This effect compensated for the additional fifth stage errors. The large velocity bias effects present in the four stage mission was also decreased substantially.

TABLE 11. ESCAPE MISSION INPUT DATA AND NOMINAL TRAJECTORY PITCH PROFILE:

| Time (sec) | Pitch Rate (deg/sec) |
|---|---|
| 0 | 0 |
| 3. | -2.625 |
| 10. | - .813 |
| 31. | - .700 |
| 42.2 | - .461 |
| 76.0 | - .081 |
| 83.42 | - .432 |
| 126.44 | + .400 |
| 144.83 | - .346 |
| 183.73 | - .569 |

| | |
|---|---|
| Coast Periods | |
| First Stage Coast | 7.42 sec |
| Second Stage Coast | 22.39 sec |
| Third Stage Coast | 3.33 sec |
| Fourth Stage Coast | 9.5 sec |
| Launch Azimuth | 90 deg |
| Launch Position: | |
| Geodetic Latitude | 37.8479 deg |
| Longitude | -75.4739 deg |
| Altitude | 0.0 feet |

TABLE 11 ESCAPE MISSION INPUT DATA AND NOMINAL TRAJECTORY PITCH PROFILE: (Cont'd)

Fifth-Stage Data:

| time-sec | lbs Cons Wt remaining | lbs Thrust | Sta. c.g.-in | Roll, $I_x$ | Pitch $I_y$ |
|---|---|---|---|---|---|
| 0.00 | 194.85 | 0.00 | 15.36 | 2.62 | 12.57 |
| 0.82 | 179.35 | 5905.0 | 14.88 | 2.56 | 12.23 |
| 1.67 | 162.80 | 6080.0 | 14.40 | 2.46 | 11.88 |
| 2.53 | 145.70 | 6455.0 | 13.92 | 2.36 | 11.54 |
| 3.42 | 128.23 | 6210.0 | 13.32 | 2.24 | 11.18 |
| 4.33 | 110.98 | 6030.0 | 12.72 | 2.10 | 10.86 |
| 5.19 | 93.93 | 5975.0 | 12.12 | 1.97 | 10.62 |
| 6.07 | 76.85 | 5960.0 | 11.40 | 1.80 | 10.36 |
| 6.95 | 59.94 | 5940.0 | 10.80 | 1.66 | 10.12 |
| 7.81 | 42.99 | 5920.0 | 9.96 | 1.48 | 9.89 |
| 8.69 | 26.00 | 5600.0 | 9.00 | 1.30 | 9.65 |
| 9.55 | 9.13 | 50.0 | 7.92 | 1.10 | 9.42 |
| 10.01 | 0.00 | 0.0 | 7.56 | .98 | 9.42 |

Nominal Conditions at Fifth Stage Burnout

Time: 240 sec

Altitude: 679,627 ft

Velocity: 39,199 ft/sec

Flight Path Angle 11.77 deg

Semi-major Axis -60.673 x $10^8$ ft

Eccentricity 1.342

Inclination 37.66 deg

Inertial Longitude 293.59 deg

Declination 37.317 deg

TABLE 11. STATISTICAL SUMMARY OF THE ESCAPE MISSION ERROR ANALYSIS RESULTS

DISPERSION OF THE SEMIMAJOR AXIS(FT.)

| | | |
|---|---|---|
| MEAN | = | -5.4098694D 04 |
| STANDARD DEVIATION | = | 1.8169138D 06 |
| SMALLEST SAMPLE | = | -5.0291464E 06 |
| 2ND PERCENTILE SAMPLE | = | -3.9395505E 06 |
| 5TH PERCENTILE SAMPLE | = | -2.9435135E 06 |
| 95TH PERCENTILE SAMPLE | = | 2.7749790E 06 |
| 98TH PERCENTILE SAMPLE | = | 3.5809730E 06 |
| LARGEST SAMPLE | = | 6.0420049E 06 |

ECCENTRICITY DISPERSION

| | | |
|---|---|---|
| MEAN | = | 1.1023506D-05 |
| STANDARD DEVIATION | = | 1.0178485D-02 |
| SMALLEST SAMPLE | = | -2.6119009E-02 |
| 2ND PERCENTILE SAMPLE | = | -2.0592809E-02 |
| 5TH PERCENTILE SAMPLE | = | -1.5223548E-02 |
| 95TH PERCENTILE SAMPLE | = | 1.6832843E-02 |
| 98TH PERCENTILE SAMPLE | = | 2.0971969E-02 |
| LARGEST SAMPLE | = | 3.9007366E-02 |

INCLINATION DISPERSION (DEGREES)

| | | |
|---|---|---|
| MEAN | = | 1.6885141D-02 |
| STANDARD DEVIATION | = | 4.5528176D-02 |
| SMALLEST SAMPLE | = | -1.8545580E-01 |
| 2ND PERCENTILE SAMPLE | = | -7.0724010E-02 |
| 5TH PERCENTILE SAMPLE | = | -5.6196213E-02 |
| 95TH PERCENTILE SAMPLE | = | 8.7185383E-02 |
| 98TH PERCENTILE SAMPLE | = | 1.0744667E-01 |
| LARGEST SAMPLE | = | 2.3364782E-01 |

LONG. OF ASCENDING NODE DISPERSION (DEGREES)

| | | |
|---|---|---|
| MEAN | = | 3.6453081D-02 |
| STANDARD DEVIATION | = | 5.0430221D-01 |
| SMALLEST SAMPLE | = | -3.2027664E 00 |
| 2ND PERCENTILE SAMPLE | = | -9.4781303E-01 |
| 5TH PERCENTILE SAMPLE | = | -7.3487282E-01 |
| 95TH PERCENTILE SAMPLE | = | 8.6254501E-01 |
| 98TH PERCENTILE SAMPLE | = | 1.0262108E 00 |
| LARGEST SAMPLE | = | 1.5043888E 00 |

ARGUMENT OF PERIGEE DISPERSION (DEGREES)

| | | |
|---|---|---|
| MEAN | = | -3.6826250D-02 |
| STANDARD DEVIATION | = | 7.6414563D-01 |
| SMALLEST SAMPLE | = | -2.2351227E 00 |
| 2ND PERCENTILE SAMPLE | = | -1.5841312E 00 |
| 5TH PERCENTILE SAMPLE | = | -1.2836466E 00 |
| 95TH PERCENTILE SAMPLE | = | 1.1474323E 00 |
| 98TH PERCENTILE SAMPLE | = | 1.4977131E 00 |
| LARGEST SAMPLE | = | 2.7279234E 00 |

DISPERSION OF ARC LENGTH ALONG ORBIT (NM)

| | | |
|---|---|---|
| MEAN | = | -1.4990142D 00 |
| STANDARD DEVIATION | = | 2.3955449D 01 |
| SMALLEST SAMPLE | = | -7.0836731E 01 |
| 2ND PERCENTILE SAMPLE | = | -4.9756896E 01 |
| 5TH PERCENTILE SAMPLE | = | -4.0018737E 01 |
| 95TH PERCENTILE SAMPLE | = | 3.6396118E 01 |
| 98TH PERCENTILE SAMPLE | = | 4.4561157E 01 |
| LARGEST SAMPLE | = | 1.5092627E 02 |

RADIUS VECTOR DISPERSION (FT)

| | | |
|---|---|---|
| MEAN | = | 2.5822219D 03 |
| STANDARD DEVIATION | = | 3.0558175D 04 |
| SMALLEST SAMPLE | = | -9.3401500E 04 |
| 2ND PERCENTILE SAMPLE | = | -6.2241500E 04 |
| 5TH PERCENTILE SAMPLE | = | -4.6287500E 04 |
| 95TH PERCENTILE SAMPLE | = | 5.1164250E 04 |
| 98TH PERCENTILE SAMPLE | = | 6.7577500E 04 |
| LARGEST SAMPLE | = | 9.8796250E 04 |

INERTIAL VELOCITY DISPERSION (FPS)

| | | |
|---|---|---|
| MEAN | = | -2.0226798D 00 |
| STANDARD DEVIATION | = | 7.8724198D 01 |
| SMALLEST SAMPLE | = | -2.3464990E 02 |
| 2ND PERCENTILE SAMPLE | = | -1.5807861E 02 |
| 5TH PERCENTILE SAMPLE | = | -1.3157764E 02 |
| 95TH PERCENTILE SAMPLE | = | 1.2882373E 02 |
| 98TH PERCENTILE SAMPLE | = | 1.6031934E 02 |
| LARGEST SAMPLE | = | 2.5061621E 02 |

AIRSPEED DISPERSION (FPS)

| | | |
|---|---|---|
| MEAN | = | -1.8298052D 00 |
| STANDARD DEVIATION | = | 7.8945611D 01 |
| SMALLEST SAMPLE | = | -2.3756836E 02 |
| 2ND PERCENTILE SAMPLE | = | -1.5806348E 02 |
| 5TH PERCENTILE SAMPLE | = | -1.3037890E 02 |
| 95TH PERCENTILE SAMPLE | = | 1.2856494E 02 |
| 98TH PERCENTILE SAMPLE | = | 1.6292920E 02 |
| LARGEST SAMPLE | = | 2.4808057E 02 |

INERTIAL FLIGHT PATH ANGLE DISPERSION (DEGREES)

| | | |
|---|---|---|
| MEAN | = | -7.2390754D-03 |
| STANDARD DEVIATION | = | 3.7744043D-01 |
| SMALLEST SAMPLE | = | -9.6414053E-01 |
| 2ND PERCENTILE SAMPLE | = | -7.5141764E-01 |
| 5TH PERCENTILE SAMPLE | = | -6.7253959E-01 |
| 95TH PERCENTILE SAMPLE | = | 6.2411928E-01 |
| 98TH PERCENTILE SAMPLE | = | 7.4625742E-01 |
| LARGEST SAMPLE | = | 1.4544786E 00 |

## ATMOSPHERIC FLIGHT PATH ANGLE DISPERSION (DEGREES)

| | | |
|---|---|---|
| MEAN | = | -7.4424780D-03 |
| STANDARD DEVIATION | = | 3.8957668D-01 |
| SMALLEST SAMPLE | = | -9.9504232E-01 |
| 2ND PERCENTILE SAMPLE | = | -7.7478158E-01 |
| 5TH PERCENTILE SAMPLE | = | -6.9403327E-01 |
| 95TH PERCENTILE SAMPLE | = | 6.4494646E-01 |
| 98TH PERCENTILE SAMPLE | = | 7.6998055E-01 |
| LARGEST SAMPLE | = | 1.5011804E 00 |

## APOGEE DISPERSION (NM)

| | | |
|---|---|---|
| MEAN | = | -1.7939328D 01 |
| STANDARD DEVIATION | = | 5.9938976D 02 |
| SMALLEST SAMPLE | = | -1.6566194E 03 |
| 2ND PERCENTILE SAMPLE | = | -1.3063313E 03 |
| 5TH PERCENTILE SAMPLE | = | -9.7197704E 02 |
| 95TH PERCENTILE SAMPLE | = | 9.2136986E 02 |
| 98TH PERCENTILE SAMPLE | = | 1.1822742E 03 |
| LARGEST SAMPLE | = | 1.9788460E 03 |

## PERIGEE DISPERSION (NM)

| | | |
|---|---|---|
| MEAN | = | 1.3228584D-01 |
| STANDARD DEVIATION | = | 6.3033234D 00 |
| SMALLEST SAMPLE | = | -1.6904144E 01 |
| 2ND PERCENTILE SAMPLE | = | -1.2525665E 01 |
| 5TH PERCENTILE SAMPLE | = | -1.0742615E 01 |
| 95TH PERCENTILE SAMPLE | = | 1.0363922E 01 |
| 98TH PERCENTILE SAMPLE | = | 1.3788238E 01 |
| LARGEST SAMPLE | = | 2.2240722E 01 |

## PERIOD DISPERSION (SEC)

| | | |
|---|---|---|
| MEAN | = | -4.1881847D 01 |
| STANDARD DEVIATION | = | 1.1244949D 03 |
| SMALLEST SAMPLE | = | -3.1755149E 03 |
| 2ND PERCENTILE SAMPLE | = | -2.4768352E 03 |
| 5TH PERCENTILE SAMPLE | = | -1.8432788E 03 |
| 95TH PERCENTILE SAMPLE | = | 1.6972954E 03 |
| 98TH PERCENTILE SAMPLE | = | 2.1827852E 03 |
| LARGEST SAMPLE | = | 3.6439482E 03 |

## LONGITUDE DISPERSION (DEGREES)

| | | |
|---|---|---|
| MEAN | = | 7.1442789D-03 |
| STANDARD DEVIATION | = | 2.8098973D-02 |
| SMALLEST SAMPLE | = | -7.8540802E-02 |
| 2ND PERCENTILE SAMPLE | = | -4.8784256E-02 |
| 5TH PERCENTILE SAMPLE | = | -4.0257454E-02 |
| 95TH PERCENTILE SAMPLE | = | 5.4620743E-02 |
| 98TH PERCENTILE SAMPLE | = | 6.5712929E-02 |
| LARGEST SAMPLE | = | 1.0338879E-01 |

LATITUDE DISPERSION (DGREES)

| | | |
|---|---|---|
| MEAN | = | 1.8003647D-02 |
| STANDARD DEVIATION | = | 4.4571565D-02 |
| SMALLEST SAMPLE | = | -2.1982241E-01 |
| 2ND PERCENTILE SAMPLE | = | -7.1645737E-02 |
| 5TH PERCENTILE SAMPLE | = | -5.7895660E-02 |
| 95TH PERCENTILE SAMPLE | = | 8.9109421E-02 |
| 98TH PERCENTILE SAMPLE | = | 1.0219049E-01 |
| LARGEST SAMPLE | = | 1.5267134E-01 |

ALTITUDE DISPERSION (NM)

| | | |
|---|---|---|
| MEAN | = | 4.2497951D-01 |
| STANDARD DEVIATION | = | 5.0292293D 00 |
| SMALLEST SAMPLE | = | -1.5371993E 01 |
| 2ND PERCENTILE SAMPLE | = | -1.0243593E 01 |
| 5TH PERCENTILE SAMPLE | = | -7.6180258E 00 |
| 95TH PERCENTILE SAMPLE | = | 8.4205933E 00 |
| 98TH PERCENTILE SAMPLE | = | 1.1121825E 01 |
| LARGEST SAMPLE | = | 1.6259771E 01 |

TABLE 13. SIGNIFICANT ERROR SOURCES AND THEIR THREE SIGMA CONTRIBUTIONS AT FIFTH STAGE BURNOUT

| Error Source | 1σ Mag. | Altitude (feet) | Velocity (ft/sec) | Flt. Path Angle (deg) | Inclination (deg) |
|---|---|---|---|---|---|
| SIW1 First Stage Inert Weight | .83% | 8720 | | .0557 | |
| ISP1 Specific Impulse - First Stage | .18% | 15973 | 18.07 | .1059 | |
| MFR1 Flow Rate - First Stage | 1.4% | 18304 | 19.71 | .1056 | |
| DKSG Torquer Scale Factor | .35% | 6156 | 24.36 | .0826 | |
| TMP1 Pitch Thrust Misalignment - First Stage | 1.67 mrad | 14741 | -65.43 | | .0639 |
| TMY1 Yaw Thrust Misalignment - First Stage | 1.67 mrad | 6895 | | | |
| CAO1 Drag Coefficient | 1% | 6615 | | | |
| DRHO Density | 6.67% | 4218 | | .2673 | |
| FWN1 Wind Effects | | | | | .0179 |
| TIM1 Timer Step Uncertainty | .078 sec | 12343 | 28.96 | .0739 | |
| ISP2 Specific Impulse - Second Stage | .094% | 6401 | | | |
| MFR2 Flow Rate - Second Stage | 1% | 7002 | 16.63 | .0596 | |
| DBY2 Yaw Dead Band - Second Stage | 10% | | | | .0136 |
| TMP2 Pitch Thrust Misalignment - Second Stage | 1.67 mrad | -51023 | 54.89 | -.0349 | |
| TMY2 Yaw Thrust Misalignment - Second Stage | 1.67 mrad | | | | .0554 |
| ISP3 Specific Impulse - Third Stage | .14% | | 27.17 | .0687 | |

TABLE 13. (CONTINUED)

| Error Source | 1 Mag. | Altitude (feet) | Velocity (ft/sec) | Flt. Path Angle (deg) | Inclination (deg) |
|---|---|---|---|---|---|
| MFR3<br>Flow Rate - Third Stage | 1.8% | | 24.44 | | |
| TMP3<br>Pitch Thrust Misalignment - Third Stage | .557 mrad | 14860 | 41.95 | .1194 | |
| TMY3<br>Yaw Thrust Misalignment - Third Stage | .557 mrad | | | | -.0136 |
| ISP4<br>Specific Impulse - Fourth Stage | .6% | | 14.99 | | |
| W4CP<br>Pitch Coning Rate - Fourth Stage | .03 rad/sec | | 17.41 | -.0633 | .0467 |
| W4CY<br>Yaw Coning Rate - Fourth Stage | .03 rad/sec | | 69.88 | .5886 | |
| MFR5<br>Flow Rate - Fifth Stage | 1.8% | | -52.66 | -.1054 | |
| ISP 5<br>Specific Impulse - Fifth Stage | .15% | | 48.94 | | |
| W5CP<br>Pitch Coning Rate - Fifth Stage | .0463 rad/sec | | -19.77 | | .0719 |
| W5CY<br>Yaw Coning Rate - Fifth Stage | .0463 rad/sec | | -25.71 | .5726 | |

TABLE 14. INDIVIDUAL THREE SIGMA ERROR SOURCE CONTRIBUTIONS AT SECOND STAGE IGNITION

| | CODE | STND.DEV. | RANGE DEVIATION (FT) | VELOCITY DEV. (FPS) | FLT. PATH ANGLE DEV. (DEG) | INCL.DEV. (DEG) |
|---|---|---|---|---|---|---|
| 1 | PW10 | 6.000000E-04 | 2.240000E 02 | -8.892822E-02 | 4.820854E-02 | 8.964623E-06 |
| 2 | SIW1 | 8.300000E-03 | 1.003750E 03 | -1.571960E 00 | 2.639217E-01 | 5.293397E-05 |
| 3 | SIW2 | 4.100000E-03 | 3.315000E 02 | -5.292358E-01 | 8.704457E-02 | 5.549529E-06 |
| 4 | SIW3 | 9.300000E-04 | 1.202500E 02 | -1.937866E-01 | 3.165814E-02 | 0. |
| 5 | SIW4 | 2.400000E-03 | 2.475000E 01 | -3.967285E-02 | 6.471177E-03 | -1.707547E-06 |
| 6 | ISP1 | 1.800000E-03 | 1.940500E 03 | 2.703149E 01 | 3.307242E-01 | 1.054410E-04 |
| 7 | MFR1 | 1.400000E-02 | 2.372000E 03 | 2.859729E 01 | 3.578949E-01 | 1.182476E-04 |
| 8 | KRIA | 1.030000E-07 | -2.500000E-01 | 2.029419E-01 | -9.969941E-04 | 0. |
| 9 | KPSA | 1.080000E-07 | 2.475000E 01 | -1.608276E-01 | 9.063447E-03 | -8.537736E-07 |
| 10 | KYIA | 1.030000E-07 | 0. | 2.199097E-01 | -1.098166E-03 | 0. |
| 11 | THOR | 9.250000E-05 | 0. | 2.465820E-01 | -1.269775E-03 | -1.494104E-05 |
| 12 | THOP | 5.760000E-05 | 3.375000E 01 | 6.822510E-01 | 5.664148E-03 | -1.579481E-05 |
| 13 | THOY | 5.430000E-05 | 5.000000E-01 | 2.133179E-01 | -9.961404E-04 | -3.158962E-05 |
| 14 | DTER | 3.280000E-06 | 0. | 1.397705E-01 | -7.282689E-04 | -2.988208E-06 |
| 15 | DTEP | 1.250000E-06 | 2.450000E 01 | 5.549316E-01 | 4.839189E-03 | -3.841981E-06 |
| 16 | DTEY | 2.000000E-06 | 0. | 3.361206E-01 | -1.749382E-03 | -8.110849E-06 |
| 17 | DKSG | 3.500000E-03 | 1.180000E 03 | 2.508142E 01 | 2.201494E-01 | -9.775708E-05 |
| 18 | DRBE | 3.570000E-03 | 3.000000E 00 | 3.795410E 00 | -1.838431E-02 | 4.490849E-04 |
| 19 | DYBE | 3.570000E-03 | 1.000000E 00 | 5.415039E 00 | -2.726804E-02 | 1.314811E-03 |
| 20 | DPBE | 3.570000E-03 | 8.350000E 02 | -5.069885E 00 | 2.508605E-01 | 4.601840E-04 |
| 21 | TYRG | 1.450000E-03 | 0. | 5.212402E-02 | -2.655236E-04 | -3.970047E-05 |
| 22 | TRRG | 1.450000E-03 | 0. | 0. | 0. | -8.537736E-07 |
| 23 | KPP1 | 2.430000E-02 | 3.875000E 01 | 5.249023E-01 | 2.810623E-03 | -7.000944E-05 |
| 24 | KPR1 | 3.060000E-02 | 0. | 0. | 0. | -8.537736E-07 |
| 25 | KPY1 | 2.330000E-02 | 0. | 4.180908E-02 | -2.121627E-04 | 1.280660E-06 |
| 26 | KRP1 | 4.400000E-02 | 1.277500E 02 | -6.798096E-01 | 3.189186E-02 | 1.011722E-04 |
| 27 | KRY1 | 2.100000E-02 | -2.500000E-01 | 3.051758E-04 | 4.268868E-07 | -8.537736E-07 |
| 28 | KRR1 | 2.620000E-02 | 0. | 0. | 0. | -8.537736E-07 |
| 29 | KPAN | 3.130000E-11 | 5.000000E-01 | 1.165771E-02 | 1.028797E-04 | -1.707547E-06 |
| 30 | KRAN | 3.120000E-11 | 0. | 3.112793E-03 | -1.451415E-05 | -1.707547E-06 |
| 31 | KYAN | 3.130000E-11 | -2.500000E-01 | 4.455566E-03 | -2.070401E-05 | -1.707547E-06 |
| 32 | TMP1 | 1.670000E-03 | 4.379750E 03 | -4.425409E 01 | 1.385622E 00 | 7.345868E-03 |
| 33 | TMY1 | 1.670000E-03 | 1.069000E 03 | 3.071185E 01 | 7.709491E-02 | 2.437097E-02 |
| 34 | CA01 | 10.000000E-03 | 6.577500E 02 | -1.627197E 00 | 2.023958E-01 | 1.792925E-05 |
| 35 | CNAL | 2.000000E-01 | 6.770000E 02 | -2.382996E 00 | 1.871436E-01 | 1.498373E-04 |
| 36 | CNDQ | 2.000000E-01 | -9.550000E 01 | 2.710571E-01 | -2.225681E-02 | -4.653066E-05 |
| 37 | CYBA | 3.300000E-01 | 2.500000E 00 | 7.098389E-01 | -2.894506E-03 | 9.476887E-05 |
| 38 | CYDR | 3.300000E-01 | -1.000000E 00 | 9.619141E-02 | -6.544175E-04 | -1.792925E-05 |
| 39 | CLDP | 1.000000E-01 | 0. | 0. | 0. | -8.537736E-07 |
| 40 | CLP1 | 1.000000E-01 | 0. | 0. | 0. | -8.537736E-07 |
| 41 | CMDQ | 2.000000E-03 | 2.250000E 00 | 4.553223E-02 | 4.522866E-04 | 0. |
| 42 | CMQ1 | 2.000000E-03 | 5.000000E-01 | 1.409912E-02 | 1.178208E-04 | -8.537736E-07 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 43 | CMAL | 2.000000E-03 | 4.000000E 00 | 6.481934E-02 | 7.918750E-04 | -5.122642E-06 |
| 44 | CM01 | 9.000000E-02 | 4.352500E 02 | -3.123047E 00 | 1.562775E-01 | 6.232548E-05 |
| 45 | NCBA | 3.300000E-01 | -6.750000E 00 | 7.241211E-01 | -5.581118E-03 | -1.327618E-04 |
| 46 | NCDR | 3.300000E-01 | 1.250000E 00 | 3.114014E-01 | -1.157077E-03 | 1.067217E-05 |
| 47 | NCR1 | 3.300000E-01 | -2.500000E-01 | 1.525879E-03 | -4.695755E-06 | -8.537736E-07 |
| 48 | DRHO | 6.670000E-02 | 3.977000E 03 | -1.749060E 01 | 1.276965E 00 | 1.861227E-03 |
| 49 | FWN1 | 10.000000E-01 | 3.150000E 01 | 2.492676E 00 | 4.091497E-03 | 2.298359E-03 |
| 50 | CNDR | 5.760000E-05 | 7.500000E-01 | 1.287842E-02 | 1.227300E-04 | -2.988208E-06 |
| 51 | CYDQ | 5.760000E-05 | 0. | 5.371094E-03 | -1.878302E-05 | -5.976415E-06 |
| 52 | CLDR | 5.760000E-05 | -2.500000E-01 | 2.624512E-03 | -1.195283E-05 | -2.988208E-06 |
| 53 | CLDQ | 5.760000E-05 | 0. | 2.160645E-02 | -1.077889E-04 | -2.134434E-06 |
| 54 | CMDR | 5.760000E-05 | 0. | 1.831055E-04 | 1.920991E-06 | -8.537736E-07 |
| 55 | NCDQ | 5.760000E-05 | 0. | 5.493164E-04 | -2.774764E-06 | -8.537736E-07 |
| 56 | LSMY | 10.000000E-03 | 5.000000E-01 | 1.146851E-01 | -3.069316E-04 | 4.695755E-06 |
| 57 | LSMP | 10.000000E-03 | 9.750000E 00 | -4.747314E-01 | 6.979813E-03 | 8.153538E-05 |
| 58 | MSMP | 1.000000E-01 | 4.850000E 01 | -2.426147E-01 | 1.696534E-02 | -2.988208E-06 |
| 59 | MSMR | 1.000000E-01 | 5.035000E 02 | -2.722107E 00 | 1.774946E-01 | 7.086321E-05 |
| 60 | NSMY | 1.000000E-01 | -5.000000E-01 | 5.401611E-02 | -3.590118E-04 | -3.756604E-05 |
| 61 | NSMR | 1.000000E-01 | -2.750000E 00 | 4.345520E 00 | -2.327771E-02 | 3.632807E-04 |
| 62 | CDV1 | 1.000000E-01 | -5.635000E 02 | -7.635254E 00 | -9.554175E-02 | 2.006368E-05 |
| 63 | CDV2 | 1.000000E-01 | -2.657500E 02 | -3.633179E 00 | -4.521372E-02 | 5.549529E-06 |
| 64 | CDV3 | 1.000000E-01 | -2.657500E 02 | -3.633179E 00 | -4.521372E-02 | 5.549529E-06 |
| 65 | LDA2 | 1.000000E-01 | 6.775000E 01 | 3.108521E-01 | 2.038619E-02 | -5.677595E-05 |
| 66 | TIM1 | 7.800000E-02 | 2.687500E 03 | -1.536707E 01 | 8.138922E-01 | 1.866349E-03 |
| 67 | TIM2 | 4.000000E-03 | 1.035000E 02 | 2.082764E 00 | 1.839477E-02 | -3.116274E-05 |
| 68 | TIM3 | 3.000000E-03 | 3.750000E 00 | 9.295654E-02 | 8.083102E-04 | -9.391510E-06 |
| 69 | TIM4 | 3.000000E-03 | 1.500000E 00 | 4.595947E-02 | 4.014871E-04 | -4.695755E-06 |

TABLE 15. INDIVIDUAL THREE SIGMA ERROR SOURCE CONTRIBUTIONS AT THIRD STAGE IGNITION

| | CODE | STND.DEV. | RANGE DEVIATION (FT) | VELOCITY DEV. (FPS) | FLT. PATH ANGLE DEV. (DEG) | INCL.DEV. (DEG) |
|---|---|---|---|---|---|---|
| 1 | PW10 | 6.000000E-04 | 4.487500E 02 | -6.325684E-01 | 1.875751E-02 | 2.475944E-05 |
| 2 | SIW1 | 8.300000E-03 | 2.204250E 03 | -4.488892E 00 | 1.013605E-01 | 1.447146E-04 |
| 3 | SIW2 | 4.100000E-03 | 7.275000E 02 | -1.484497E 00 | 3.342769E-02 | 4.653066E-05 |
| 4 | SIW3 | 9.300000E-04 | 2.642500E 02 | -5.406494E-01 | 1.215720E-02 | 1.622170E-05 |
| 5 | SIW4 | 2.400000E-03 | 5.400000E 01 | -1.104736E-01 | 2.483307E-03 | 1.280660E-06 |
| 6 | ISP1 | 1.800000E-03 | 4.153500E 03 | 2.278906E 01 | 1.591243E-01 | -2.612547E-04 |
| 7 | MFR1 | 1.400000E-02 | 5.039000E 03 | 2.491345E 01 | 1.709066E-01 | -3.555967E-04 |
| 8 | KRIA | 1.030000E-07 | 0. | 5.688477E-02 | -2.358550E-05 | 5.848349E-05 |
| 9 | KPSA | 1.080000E-07 | 6.100000E 01 | -2.489014E-01 | 3.212323E-03 | 4.695755E-06 |
| 10 | KYIA | 1.030000E-07 | 2.500000E-01 | 6.225586E-02 | -7.161026E-05 | -2.915637E-04 |
| 11 | THOR | 9.250000E-05 | 7.500000E-01 | 7.116699E-02 | -7.086321E-05 | -3.393750E-04 |
| 12 | THOP | 5.760000E-05 | 7.375000E 01 | 5.836182E-01 | 2.849896E-03 | -1.237972E-05 |
| 13 | THOY | 5.430000E-05 | 1.750000E 00 | 6.506348E-02 | -2.582665E-05 | -3.052241E-04 |
| 14 | DTER | 3.280000E-06 | 0. | 3.955078E-02 | -4.226179E-05 | -1.886840E-04 |
| 15 | DTEP | 1.250000E-06 | 5.800000E 01 | 4.729004E-01 | 2.389392E-03 | -8.110849E-06 |
| 16 | DTEY | 2.000000E-06 | 7.500000E-01 | 9.606934E-02 | -1.025596E-04 | -1.088561E-04 |
| 17 | DKSG | 3.500000E-03 | 2.716000E 03 | 2.128992E 01 | 1.089803E-01 | -3.269953E-04 |
| 18 | DRBE | 3.570000E-03 | 1.200000E 01 | 1.081543E 00 | -3.743797E-04 | 1.357073E-03 |
| 19 | DYBE | 3.570000E-03 | 6.500000E 00 | 1.538574E 00 | -9.419258E-04 | 2.506679E-03 |
| 20 | DPBE | 3.570000E-03 | 1.823000E 03 | -7.464111E 00 | 8.784071E-02 | 2.843066E-04 |
| 21 | TYRG | 1.450000E-03 | 0. | 1.525879E-02 | -1.398054E-05 | -7.385142E-05 |
| 22 | TRRG | 1.450000E-03 | 0. | 0. | 2.134434E-07 | -2.134434E-06 |
| 23 | KPP1 | 2.430000E-02 | 6.100000E 01 | 4.614258E-01 | 1.698156E-03 | -2.774764E-05 |
| 24 | KPR1 | 3.060000E-02 | 0. | 0. | 0. | -2.134434E-06 |
| 25 | KPY1 | 2.330000E-02 | -2.500000E-01 | 1.159668E-02 | -7.363798E-06 | 1.408726E-05 |
| 26 | KRP1 | 4.400000E-02 | 2.527500E 02 | -9.709473E-01 | 1.108700E-02 | 4.951887E-05 |
| 27 | KRY1 | 2.100000E-02 | -2.500000E-01 | 0. | 9.604953E-07 | -1.280660E-06 |
| 28 | KRR1 | 2.620000E-02 | 0. | 0. | 0. | -2.134434E-06 |
| 29 | KPAN | 3.130000E-11 | 1.000000E 00 | 9.887695E-03 | 5.079953E-05 | -2.134434E-06 |
| 30 | KRAN | 3.120000E-11 | -2.500000E-01 | 7.324219E-04 | -2.134434E-07 | 0. |
| 31 | KYAN | 3.130000E-11 | 0. | 1.220703E-03 | -7.470519E-07 | 0. |
| 32 | TMP1 | 1.670000E-03 | 9.327250E 03 | -5.785132E 01 | 4.610628E-01 | 2.239875E-03 |
| 33 | TMY1 | 1.670000E-03 | 2.114750E 03 | 5.481567E 00 | 8.279619E-02 | 1.911002E-02 |
| 34 | CA01 | 10.000000E-03 | 1.566250E 03 | -3.824219E 00 | 7.717431E-02 | 1.075755E-04 |
| 35 | CNAL | 2.000000E-01 | 1.453500E 03 | -4.197998E 00 | 6.753072E-02 | 1.430071E-04 |
| 36 | CNDQ | 2.000000E-01 | -1.885000E 02 | 4.791260E-01 | -8.024938E-03 | -2.732076E-05 |
| 37 | CYBA | 3.300000E-01 | 6.750000E 00 | 2.218018E-01 | 1.185678E-04 | 2.877217E-04 |
| 38 | CYDR | 3.300000E-01 | -1.500000E 00 | 2.832031E-02 | -1.001050E-04 | -1.464222E-04 |
| 39 | CLDP | 1.000000E-01 | 0. | 0. | 0. | -2.134434E-06 |
| 40 | CLP1 | 1.000000E-01 | 0. | 0. | 0. | -2.134434E-06 |
| 41 | CMDQ | 2.000000E-03 | 5.500000E 00 | 3.796387E-02 | 2.026645E-04 | -1.280660E-06 |
| 42 | CMQ1 | 2.000000E-03 | 1.500000E 00 | 1.196289E-02 | 5.368102E-05 | -1.280660E-06 |

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|---|---|---|---|---|---|---|
| 43 | CMAL | 2.000000E-03 | 9.250000E 00 | 5.261230E-02 | 3.671227E-04 | -3.841981E-06 |
| 44 | CM01 | 9.000000E-02 | 1.052750E 03 | -4.672363E 00 | 5.512646E-02 | 1.169670E-04 |
| 45 | NCBA | 3.300000E-01 | -1.550000E 01 | -2.801514E-01 | -4.235784E-04 | -3.543161E-04 |
| 46 | NCDR | 3.300000E-01 | 3.500000E 00 | 1.020508E-01 | 9.124706E-05 | 9.391510E-05 |
| 47 | NCR1 | 3.300000E-01 | -2.500000E-01 | 4.882813E-04 | 9.604953E-07 | 0. |
| 48 | DRHO | 6.670000E-02 | 9.538250E 03 | -3.225317E 01 | 4.814220E-01 | 9.412854E-04 |
| 49 | FWN1 | 10.000000E-01 | 2.135000E 02 | 1.406372E 00 | 1.221003E-02 | -2.227069E-03 |
| 50 | CNDR | 5.760000E-05 | 1.500000E 00 | 1.074219E-02 | 6.029776E-05 | -2.134434E-06 |
| 51 | CYDQ | 5.760000E-05 | 0. | 1.708984E-03 | 1.707547E-06 | -8.537736E-06 |
| 52 | CLDR | 5.760000E-05 | -2.500000E-01 | 6.103516E-04 | -1.067217E-07 | -1.280660E-06 |
| 53 | CLDQ | 5.760000E-05 | -2.500000E-01 | 5.859375E-03 | -2.881486E-06 | 4.695755E-06 |
| 54 | CMDR | 5.760000E-05 | 0. | 1.220703E-04 | 8.537736E-07 | -2.134434E-06 |
| 55 | NCDC | 5.760000E-05 | 0. | 0. | 0. | -1.280660E-06 |
| 56 | LSMY | 10.000000E-03 | 2.000000E 00 | 4.248047E-02 | 6.125826E-05 | -1.220896E-04 |
| 57 | LSMP | 10.000000E-03 | 3.125000E 01 | -2.277832E-01 | 1.950873E-03 | -3.372406E-05 |
| 58 | MSMP | 1.000000E-01 | 1.180000E 02 | -4.090576E-01 | 6.092422E-03 | 8.537736E-06 |
| 59 | MSMR | 1.000000E-01 | 1.224750E 03 | -4.470093E 00 | 6.340721E-02 | 1.229434E-04 |
| 60 | NSMY | 1.000000E-01 | -7.500000E-01 | 1.586914E-02 | -5.304069E-05 | -7.257076E-05 |
| 61 | NSMR | 1.000000E-01 | -2.750000E 00 | 1.175659E 00 | -1.201793E-03 | 1.380979E-03 |
| 62 | CDV1 | 1.000000E-01 | -1.195000E 03 | -6.489258E 00 | -4.552556E-02 | 7.171698E-05 |
| 63 | CDV2 | 1.000000E-01 | -5.650000E 02 | -3.088135E 00 | -2.157518E-02 | 3.287028E-05 |
| 64 | CDV3 | 1.000000E-01 | -5.650000E 02 | -3.088135E 00 | -2.157518E-02 | 3.287028E-05 |
| 65 | LDA2 | 1.000000E-01 | 1.677500E 02 | 3.344727E-02 | 8.185448E-03 | 1.920991E-05 |
| 66 | TIM1 | 7.800000E-02 | 5.908250E 03 | -2.343286E 01 | 2.862278E-01 | 8.670071E-04 |
| 67 | TIM2 | 4.000000E-03 | 2.312500E 02 | 1.770020E 00 | 9.101761E-03 | -3.201651E-05 |
| 68 | TIM3 | 3.000000E-03 | 9.250000E 00 | 7.922363E-02 | 3.983921E-04 | -5.549529E-06 |
| 69 | TIM4 | 3.000000E-03 | 4.500000E 00 | 3.918457E-02 | 1.969015E-04 | -3.841981E-06 |
| 70 | PW20 | 5.400000E-04 | -1.007500E 02 | -2.586914E 00 | -9.984989E-03 | -4.478043E-04 |
| 71 | ISP2 | 9.400000E-04 | 4.530000E 02 | 1.635107E 01 | 4.787440E-02 | -1.075755E-04 |
| 72 | MFR2 | 10.000000E-03 | 4.987500E 02 | 1.673132E 01 | 4.375995E-02 | -8.964623E-05 |
| 73 | KRP2 | 4.400000E-02 | 2.475000E 01 | -1.278296E 01 | -5.268883E-02 | 9.090128E-03 |
| 74 | DBP2 | 1.000000E-01 | -4.382500E 02 | 3.270874E 00 | -1.356337E-01 | -1.380979E-03 |
| 75 | KRY2 | 2.620000E-02 | 0. | 3.852539E-01 | -3.447111E-04 | -4.764057E-04 |
| 76 | DBY2 | 1.000000E-01 | 5.000000E 00 | 4.269409E 00 | -4.942282E-03 | -4.113481E-03 |
| 77 | ROE2 | 2.500000E-01 | -4 750000E 01 | -9.581299E-01 | -6.245354E-03 | 1.180342E-03 |
| 78 | TMP2 | 1.670000E-03 | -6.721000E 03 | 2.720410E 01 | -1.037914E 00 | 4.204835E-04 |
| 79 | TMY2 | 1.670000E-03 | -1.110000E 02 | -1.759094E 01 | 3.274649E-03 | 2.353726E-02 |
| 80 | C2PY | 3.300000E-03 | 0. | 1.512451E-01 | -1.523986E-04 | -1.942335E-04 |
| 81 | C2YP | 3.300000E-03 | 0. | 1.665039E-01 | -1.648850E-04 | -2.151510E-04 |
| 82 | CD02 | 1.000000E-01 | -8.200000E 01 | -2.139282E 00 | -7.796341E-03 | -2.305189E-04 |
| 83 | CNA2 | 1.000000E-01 | -1.725000E 01 | 6.241455E-01 | -8.036998E-03 | -5.741628E-04 |
| 84 | ZET2 | 1.000000E-01 | -6.750000E 00 | 5.216064E-01 | -4.804931E-03 | -5.203750E-04 |
| 85 | TIM6 | 3.000000E-03 | 0. | 1.263428E-01 | -1.243308E-04 | -1.622170E-04 |
| 86 | TIM7 | 3.000000E-03 | 0. | 0. | 1.067217E-07 | -2.134434E-06 |

TABLE 16. INDIVIDUAL THREE SIGMA ERROR SOURCE CONTRIBUTIONS AT FOURTH STAGE IGNITION

| CODE | STND.DEV. | RANGE DEVIATION (FT) | VELOCITY DEV. (FPS) | FLT. PATH ANGLE DEV. (DEG) | INCL.DEV. (DEG) |
|---|---|---|---|---|---|
| 1 PW10 | 6.000000E-04 | 1.164000E 03 | 9.916992E-01 | 1.992665E-02 | 3.713915E-05 |
| 2 SIW1 | 8.300000E-03 | 6.264750E 03 | 4.503662E 00 | 1.082256E-01 | 2.228349E-04 |
| 3 SIW2 | 4.100000E-03 | 2.066250E 03 | 1.478516E 00 | 3.569329E-02 | 7.299765E-05 |
| 4 SIW3 | 9.300000E-04 | 7.515000E 02 | 5.363770E-01 | 1.298728E-02 | 2.646698E-05 |
| 5 SIW4 | 2.400000E-03 | 1.532500E 02 | 1.098633E-01 | 2.652675E-03 | 4.695755E-06 |
| 6 ISP1 | 1.800000E-03 | 1.146200E 04 | 1.946997E 01 | 1.963754E-01 | -3.807830E-04 |
| 7 MFR1 | 1.400000E-02 | 1.248250E 04 | 2.072827E 01 | 2.116491E-01 | 1.383113E-04 |
| 8 KRIA | 1.030000E-07 | 4.750000E 00 | 2.709961E-02 | 7.865390E-05 | 1.541061E-04 |
| 9 KPSA | 1.080000E-07 | 1.075000E 02 | -2.861328E-01 | 2.032942E-03 | 5.549529E-06 |
| 10 KYIA | 1.030000E-07 | 5.250000E 00 | 2.978516E-02 | 5.709611E-05 | -3.918821E-04 |
| 11 THOR | 9.250000E-05 | 6.500000E 00 | 3.491211E-02 | 7.844045E-05 | -4.384128E-04 |
| 12 THOP | 5.760000E-05 | 1.170000E 02 | 6.418457E-01 | 2.100390E-03 | -8.964623E-06 |
| 13 THOY | 5.430000E-05 | 8.500000E 00 | 3.344727E-02 | 1.114175E-04 | -3.722453E-04 |
| 14 DTER | 3.280000E-06 | 3.250000E 00 | 1.879883E-02 | 3.895342E-05 | -2.501557E-04 |
| 15 DTEP | 1.250000E-06 | 1.000000E 02 | 5.297852E-01 | 1.784280E-03 | -7.257076E-06 |
| 16 DTEY | 2.000000E-06 | 8.500000E 00 | 4.663086E-02 | 9.754364E-05 | -5.980684E-04 |
| 17 DKSG | 3.500000E-03 | 4.601000E 03 | 2.394214E 01 | 8.193740E-02 | -2.941250E-04 |
| 18 DRBE | 3.570000E-03 | 9.825000E 01 | 5.227051E-01 | 1.570196E-03 | 2.922040E-03 |
| 19 DYBE | 3.570000E-03 | 1.187500E 02 | 7.412109E-01 | 1.836360E-03 | 4.344854E-03 |
| 20 DPBE | 3.570000E-03 | 2.873250E 03 | -8.320068E 00 | 5.454984E-02 | 2.117359E-04 |
| 21 TYRG | 1.450000E-03 | 1.250000E 00 | 7.324219E-03 | 1.803597E-05 | -9.348821E-05 |
| 22 TRRG | 1.450000E-03 | 0. | 2.441406E-04 | 1.067217E-07 | -8.537736E-07 |
| 23 KPP1 | 2.430000E-02 | 5.400000E 01 | 4.409180E-01 | 1.070205E-03 | -9.818397E-06 |
| 24 KPR1 | 3.060000E-02 | 0. | 0. | 0. | 0. |
| 25 KPY1 | 2.330000E-02 | 7.500000E-01 | 5.371094E-03 | 1.355366E-05 | 3.287028E-05 |
| 26 KRP1 | 4.400000E-02 | 3.662500E 02 | -1.057129E 00 | 6.934456E-03 | 2.817453E-05 |
| 27 KRY1 | 2.100000E-02 | 0. | -2.441406E-04 | 6.403302E-07 | 0. |
| 28 KRR1 | 2.620000E-02 | 0. | 0. | 0. | 0. |
| 29 KPAN | 3.130000E-11 | 2.000000E 00 | 1.098633E-02 | 3.756604E-05 | -8.537736E-07 |
| 30 KRAN | 3.120000E-11 | 0. | 2.441406E-04 | 0. | 2.134434E-06 |
| 31 KYAN | 3.130000E-11 | 0. | 4.882813E-04 | 6.403302E-07 | 3.415095E-06 |
| 32 TMP1 | 1.670000E-03 | 1.176375E 04 | -6.120654E 01 | 2.356105E-01 | 1.553868E-03 |
| 33 TMY1 | 1.670000E-03 | 4.985750E 03 | 7.383057E 00 | 8.596604E-02 | 2.623006E-02 |
| 34 CA01 | 10.000000E-03 | 4.746750E 03 | 3.091553E 00 | 8.250900E-02 | -8.892052E-04 |
| 35 CNAL | 2.000000E-01 | 2.492750E 03 | -4.968506E 00 | 4.606770E-02 | 1.246510E-04 |
| 36 CNDQ | 2.000000E-01 | -3.052500E 02 | 5.585938E-01 | -5.609613E-03 | -1.536793E-05 |
| 37 CYBA | 3.300000E-01 | 3.150000E 01 | 1.179199E-01 | 5.138650E-04 | 5.336085E-04 |
| 38 CYDR | 3.300000E-01 | -5.000000E 00 | 5.371094E-03 | -9.967807E-05 | -1.754505E-04 |
| 39 CLDP | 1.000000E-01 | 0. | 0. | 0. | 0. |
| 40 CLP1 | 1.000000E-01 | 0. | 0. | 0. | 0. |
| 41 CMDQ | 2.000000E-03 | 1.000000E 01 | 4.467773E-02 | 1.431138E-04 | 8.537736E-07 |

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|---|---|---|---|---|---|---|
| 42 | CMQ1 | 2.000000E-03 | 2.500000E 00 | 1.293945E-02 | 3.639210E-05 | -8.537736E-07 |
| 43 | CMAL | 2.000000E-03 | 1.750000E 01 | 6.738281E-02 | 3.038367E-04 | -1.707547E-06 |
| 44 | CM01 | 9.000000E-02 | 1.771000E 03 | -5.292725E 00 | 3.376899E-02 | 1.267854E-04 |
| 45 | NCBA | 3.300000E-01 | -5.500000E 01 | -1.628418E-01 | -9.156722E-04 | -5.835543E-04 |
| 46 | NCDR | 3.300000E-01 | 1.650000E 01 | 5.664063E-02 | 2.751286E-04 | 2.185661E-04 |
| 47 | NCR1 | 3.300000E-01 | 0. | 2.441406E-04 | 2.134434E-06 | 8.537736E-07 |
| 48 | DRHO | 6.670000E-02 | 3.020425E 04 | 1.345020E 01 | 5.245151E-01 | 1.481724E-03 |
| 49 | FWN1 | 10.000000E-01 | 1.505000E 02 | 1.475586E 00 | 8.380108E-03 | 7.010762E-03 |
| 50 | CNDR | 5.760000E-05 | 2.500000E 00 | 1.245117E-02 | 4.642394E-05 | -8.537736E-07 |
| 51 | CYDQ | 5.760000E-05 | 2.500000E-01 | 7.324219E-04 | 4.589033E-06 | -8.964623E-06 |
| 52 | CLDR | 5.760000E-05 | 0. | 2.441406E-04 | 8.537736E-07 | -5.122642E-06 |
| 53 | CLDQ | 5.760000E-05 | 5.000000E-01 | 2.441406E-03 | 7.363798E-06 | 1.536793E-05 |
| 54 | CMDR | 5.760000E-05 | 0. | 2.441406E-04 | 2.134434E-07 | -8.537736E-07 |
| 55 | NCDQ | 5.760000E-05 | 0. | 0. | -2.134434E-07 | 0. |
| 56 | LSMY | 10.000000E-03 | 9.000000E 00 | 2.612305E-02 | 1.420466E-04 | -1.716085E-04 |
| 57 | LSMP | 10.000000E-03 | 1.182500E 02 | 1.513672E-02 | 2.096014E-03 | -2.830260E-04 |
| 58 | MSMP | 1.000000E-01 | 2.147500E 02 | -4.831543E-01 | 4.025436E-03 | 1.109906E-05 |
| 59 | MSMR | 1.000000E-01 | 2.192500E 03 | -5.218262E 00 | 4.131891E-02 | 1.272123E-04 |
| 60 | NSMY | 1.000000E-01 | -2.750000E 00 | 3.417969E-03 | -5.400118E-05 | -9.604953E-05 |
| 61 | NSMR | 1.000000E-01 | 6.425000E 01 | 5.356445E-01 | 9.614558E-04 | 3.372833E-03 |
| 62 | CDV1 | 1.000000E-01 | -3.277000E 03 | -5.520020E 00 | -5.627670E-02 | 1.088561E-04 |
| 63 | CDV2 | 1.000000E-01 | -1.554500E 03 | -2.629883E 00 | -2.669878E-02 | 5.165330E-05 |
| 64 | CDV3 | 1.000000E-01 | -1.554500E 03 | -2.629883E 00 | -2.669878E-02 | 5.165330E-05 |
| 65 | LDA2 | 1.000000E-01 | 3.887500E 02 | -1.218262E-01 | 6.906602E-03 | 6.445991E-05 |
| 66 | TIM1 | 7.800000E-02 | 9.469250E 03 | -2.634839E 01 | 1.794155E-01 | 6.714930E-04 |
| 67 | TIM2 | 4.000000E-03 | 3.842500E 02 | 1.989014E 00 | 6.851320E-03 | -2.518632E-05 |
| 68 | TIM3 | 3.000000E-03 | 1.650000E 01 | 8.886719E-02 | 2.972199E-04 | -3.415095E-06 |
| 69 | TIM4 | 3.000000E-03 | 8.250000E 00 | 4.418945E-02 | 1.465289E-04 | -1.280660E-06 |
| 70 | PW20 | 5.400000E-04 | -8.307500E 02 | -2.510498E 00 | -1.525768E-02 | 6.595401E-04 |
| 71 | ISP2 | 9.400000E-04 | 4.460250E 03 | 1.497461E 01 | 8.202737E-02 | 2.527170E-04 |
| 72 | MFR2 | 10.000000E-03 | 4.646750E 03 | 1.797095E 01 | 9.758067E-02 | 1.011722E-04 |
| 73 | KRP2 | 4.400000E-02 | 1.217500E 02 | -5.566406E-02 | 2.383309E-03 | 4.742712E-04 |
| 74 | DBP2 | 1.000000E-01 | -4.737000E 03 | 4.982666E 00 | -9.717342E-02 | 2.419594E-03 |
| 75 | KRY2 | 2.620000E-02 | 2.350000E 01 | 1.782227E-01 | 4.091710E-04 | 7.423562E-04 |
| 76 | DBY2 | 1.000000E-01 | 2.185000E 02 | 2.018555E 00 | 3.615091E-03 | 8.727701E-03 |
| 77 | ROE2 | 2.500000E-01 | -3.312500E 02 | -2.014160E-01 | -6.428168E-03 | -2.301774E-03 |
| 78 | TMP2 | 1.670000E-03 | -3.764900E 04 | 4.661865E 01 | -7.505727E-01 | -1.647783E-04 |
| 79 | TMY2 | 1.670000E-03 | -1.714500E 03 | -8.411621E 00 | -3.030459E-02 | -3.233155E-02 |
| 80 | C2PY | 3.300000E-03 | 8.750000E 00 | 7.055664E-02 | 1.484499E-04 | 2.881486E-04 |
| 81 | C2YP | 3.300000E-03 | 9.500000E 00 | 7.812500E-02 | 1.665926E-04 | 3.150425E-04 |
| 82 | CD02 | 1.000000E-01 | -6.632500E 02 | -2.029053E 00 | -1.216051E-02 | 3.415095E-04 |
| 83 | CNA2 | 1.000000E-01 | -2.422500E 02 | 4.821777E-01 | -5.051032E-03 | 1.096245E-03 |
| 84 | ZET2 | 1.000000E-01 | -1.305000E 02 | 3.449707E-01 | -2.767294E-03 | 9.895236E-04 |

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|---|---|---|---|---|---|---|
| 85 | TIM6 | 3.000000E-03 | 7.500000E 00 | 5.932617E-02 | 1.272123E-04 | 2.399104E-04 |
| 86 | TIM7 | 3.000000E-03 | 0. | 2.441406E-04 | 1.067217E-07 | 0. |
| 87 | PW30 | 6.000000E-04 | 9.375000E 02 | -1.503906E 00 | 1.964864E-02 | 5.805661E-05 |
| 88 | ISP3 | 1.400000E-03 | 5.928750E 03 | 2.742993E 01 | 1.160437E-01 | -3.675495E-04 |
| 89 | MFR3 | 1.800000E-02 | 7.541500E 03 | 2.270728E 01 | 9.493621E-02 | -3.171769E-04 |
| 90 | KRP3 | 4.400000E-02 | 0. | 0. | 5.336085E-07 | -8.537736E-07 |
| 91 | DBP3 | 1.000000E-01 | 0. | 0. | 0. | 0. |
| 92 | KRY3 | 2.100000E-02 | 0. | 0. | 0. | 0. |
| 93 | DBY3 | 1.000000E-01 | 0. | 0. | 0. | 0. |
| 94 | ROE3 | 2.500000E-01 | -2.750000E 01 | -2.319336E-01 | -5.027659E-04 | -6.650897E-04 |
| 95 | TMP3 | 5.570000E-04 | 1.068200E 04 | 4.096069E 01 | 2.165460E-01 | -1.246510E-04 |
| 96 | TMY3 | 5.570000E-04 | 4.172500E 02 | -1.504150E 00 | 8.938583E-03 | -7.742873E-03 |

TABLE 17. INDIVIDUAL THREE SIGMA ERROR SOURCE CONTRIBUTIONS AT FIFTH STAGE IGNITION

TRW SYSTEMS

| | CODE | STND.DEV. | RANGE DEVIATION (FT) | VELOCITY DEV. (FPS) | FLT. PATH ANGLE DEV. (DEG) | INCL.DEV. (DEG) |
|---|---|---|---|---|---|---|
| 1 | PW10 | 6.000000E-04 | 1.544250E 03 | 1.084229E 00 | 1.424628E-02 | 4.012736E-05 |
| 2 | SIW1 | 8.300000E-03 | 8.333750E 03 | 4.986328E 00 | 7.718359E-02 | 2.369222E-04 |
| 3 | SIW2 | 4.100000E-03 | 2.748000E 03 | 1.639893E 00 | 2.545505E-02 | 7.598585E-05 |
| 4 | SIW3 | 9.300000E-04 | 9.997500E 02 | 5.954590E-01 | 9.261736E-03 | 2.689387E-05 |
| 5 | SIW4 | 2.400000E-03 | 2.042500E 02 | 1.218262E-01 | 1.891962E-03 | 4.695755E-06 |
| 6 | ISP1 | 1.800000E-03 | 1.522900E 04 | 1.836206E 01 | 1.436122E-01 | -4.102382E-04 |
| 7 | MFR1 | 1.400000E-02 | 1.755975E 04 | 1.997583E 01 | 1.430686E-01 | -2.702194E-04 |
| 8 | KRIA | 1.030000E-07 | 6.500000E 00 | 1.757813E-02 | 6.328597E-05 | 1.920991E-04 |
| 9 | KPSA | 1.080000E-07 | 1.350000E 02 | -3.134766E-01 | 1.280447E-03 | 2.134434E-06 |
| 10 | KYIA | 1.030000E-07 | 7.000000E 00 | 2.026367E-02 | 4.845165E-05 | -4.815283E-04 |
| 11 | THOR | 9.250000E-05 | 9.000000E 00 | 2.368164E-02 | 6.445991E-05 | -5.387312E-04 |
| 12 | THOP | 5.760000E-05 | 1.465000E 02 | 6.567383E-01 | 1.599758E-03 | -6.403302E-06 |
| 13 | THOY | 5.430000E-05 | 1.150000E 01 | 2.416992E-02 | 8.708491E-05 | -4.571958E-04 |
| 14 | DTER | 3.280000E-06 | 4.500000E 00 | 1.269531E-02 | 3.287028E-05 | -3.077854E-04 |
| 15 | DTEP | 1.250000E-06 | 1.257500E 02 | 5.424805E-01 | 1.353445E-03 | -4.695755E-06 |
| 16 | DTEY | 2.000000E-06 | 1.150000E 01 | 3.173828E-02 | 8.142866E-05 | -7.338184E-04 |
| 17 | DKSG | 3.500000E-03 | 5.792000E 03 | 2.451294E 01 | 6.212836E-02 | -1.677665E-04 |
| 18 | DRBE | 3.570000E-03 | 1.347500E 02 | 3.503418E-01 | 1.256968E-03 | 3.650736E-03 |
| 19 | DYBE | 3.570000E-03 | 1.642500E 02 | 4.997559E-01 | 1.514701E-03 | 5.409510E-03 |
| 20 | DPBE | 3.570000E-03 | 3.597500E 03 | -9.070068E 00 | 3.396173E-02 | 1.229434E-04 |
| 21 | TYRG | 1.450000E-03 | 2.000000E 00 | 5.126953E-03 | 1.440743E-05 | -1.152594E-04 |
| 22 | TRRG | 1.450000E-03 | 0. | 0. | 2.134434E-07 | -2.134434E-06 |
| 23 | KPP1 | 2.430000E-02 | 6.425000E 01 | 4.470215E-01 | 8.533467E-04 | -6.830189E-06 |
| 24 | KPR1 | 3.060000E-02 | 0. | 0. | 0. | -2.134434E-06 |
| 25 | KPY1 | 2.330000E-02 | 1.000000E 00 | 3.417969E-03 | 1.120578E-05 | 4.012736E-05 |
| 26 | KRP1 | 4.400000E-02 | 4.575000E 02 | -1.150635E 00 | 4.300351E-03 | 1.536793E-05 |
| 27 | KRY1 | 2.100000E-02 | 0. | 0. | 1.067217E-07 | -2.134434E-06 |
| 28 | KRR1 | 2.620000E-02 | 0. | 0. | 0. | -2.134434E-06 |
| 29 | KPAN | 3.130000E-11 | 2.500000E 00 | 1.147461E-02 | 2.881486E-05 | -2.134434E-06 |
| 30 | KRAN | 3.120000E-11 | 0. | 2.441406E-04 | 3.201651E-07 | 1.707547E-06 |
| 31 | KYAN | 3.130000E-11 | 0. | 2.441406E-04 | 5.336085E-07 | 2.561321E-06 |
| 32 | TMP1 | 1.670000E-03 | 1.425925E 04 | -6.530664E 01 | 1.352102E-01 | 1.001050E-03 |
| 33 | TMY1 | 1.670000E-03 | 6.581500E 03 | 6.367432E 00 | 6.152229E-02 | 6.941052E-02 |
| 34 | CA01 | 10.000000E-03 | 6.322500E 03 | 3.457520E 00 | 5.876823E-02 | 1.767311E-04 |
| 35 | CNAL | 2.000000E-01 | 3.159500E 03 | -5.535889E 00 | 2.962616E-02 | 6.232548E-05 |
| 36 | CNDQ | 2.000000E-01 | -3.872500E 02 | 6.250000E-01 | -3.616692E-03 | -8.964623E-06 |
| 37 | CYBA | 3.300000E-01 | 4.225000E 01 | 8.642578E-02 | 3.964711E-04 | 6.672241E-04 |
| 38 | CYDR | 3.300000E-01 | -7.250000E 00 | 9.765625E-04 | -7.064977E-05 | -2.160047E-04 |
| 39 | CLDP | 1.000000E-01 | 0. | 0. | 0. | -2.134434E-06 |
| 40 | CLP1 | 1.000000E-01 | 0. | 0. | 0. | -2.134434E-06 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 41 | CMDQ | 2.000000E-03 | 1.250000E 01 | 4.589844E-02 | 9.124706E-05 | -8.537736E-07 |
| 42 | CMQ1 | 2.000000E-03 | 3.000000E 00 | 1.342773E-02 | 2.283844E-05 | -8.537736E-07 |
| 43 | CMAL | 2.000000E-03 | 2.250000E 01 | 6.933594E-02 | 2.261433E-04 | -2.134434E-06 |
| 44 | CM01 | 9.000000E-02 | 2.218250E 03 | -5.765869E 00 | 2.103602E-02 | 7.470519E-05 |
| 45 | NCBA | 3.300000E-01 | -7.400000E 01 | -1.271973E-01 | -6.920902E-04 | -1.600399E-03 |
| 46 | NCDR | 3.300000E-01 | 2.225000E 01 | 4.296875E-02 | 2.103485E-04 | 2.744882E-04 |
| 47 | NCR1 | 3.300000E-01 | 0. | 0. | 1.494104E-06 | 0. |
| 48 | DRHO | 6.670000E-02 | 4.034550E 04 | 1.553223E 01 | 3.724113E-01 | 1.545757E-03 |
| 49 | FWN1 | 1.000000E 00 | 5.825000E 01 | 1.248535E 00 | 2.412231E-03 | 1.441255E-02 |
| 50 | CNDR | 5.760000E-05 | 3.000000E 00 | 1.269531E-02 | 3.553833E-05 | -8.537736E-07 |
| 51 | CYDQ | 5.760000E-05 | 2.500000E-01 | 7.324219E-04 | 3.094929E-06 | -1.280660E-05 |
| 52 | CLDR | 5.760000E-05 | 0. | 2.441406E-04 | 5.336085E-07 | 1.707547E-06 |
| 53 | CLDQ | 5.760000E-05 | 5.000000E-01 | 1.464844E-03 | 5.976415E-06 | 1.963679E-05 |
| 54 | CMDR | 5.760000E-05 | 0. | 0. | 5.336085E-07 | -2.134434E-06 |
| 55 | NCDQ | 5.760000E-05 | 0. | 0. | 1.067217E-07 | -8.537736E-07 |
| 56 | LSMY | 10.000000E-03 | 1.200000E 01 | 2.124023E-02 | 1.053343E-04 | -2.108821E-04 |
| 57 | LSMP | 10.000000E-03 | 1.585000E 02 | 4.296875E-02 | 1.484072E-03 | -3.590118E-04 |
| 58 | MSMP | 1.000000E-01 | 2.717500E 02 | -5.346680E-01 | 2.573167E-03 | 5.549529E-06 |
| 59 | MSMR | 1.000000E-01 | 2.768750E 03 | -5.756592E 00 | 2.627061E-02 | 7.086321E-05 |
| 60 | NSMY | 1.000000E-01 | -4.000000E 00 | 9.765625E-04 | -3.863326E-05 | -1.186745E-04 |
| 61 | NSMR | 1.000000E-01 | 9.025000E 01 | 3.378906E-01 | 8.339234E-04 | 4.217215E-03 |
| 62 | CDV1 | 1.000000E-01 | -4.354500E 03 | -5.212891E 00 | -4.115007E-02 | 1.165401E-04 |
| 63 | CDV2 | 1.000000E-01 | -2.066000E 03 | -2.483643E 00 | -1.952676E-02 | 5.464151E-05 |
| 64 | CDV3 | 1.000000E-01 | -2.066000E 03 | -2.483643E 00 | -1.952676E-02 | 5.464151E-05 |
| 65 | LDA2 | 1.000000E-01 | 5.045000E 02 | -1.918945E-01 | 4.734281E-03 | 7.555897E-05 |
| 66 | TIM1 | 7.800000E-02 | 1.187600E 04 | -2.881226E 01 | 1.121484E-01 | 3.880401E-04 |
| 67 | TIM2 | 4.000000E-03 | 4.835000E 02 | 2.036621E 00 | 5.194572E-03 | -1.536793E-05 |
| 68 | TIM3 | 3.000000E-03 | 2.100000E 01 | 9.082031E-02 | 2.252895E-04 | -2.988208E-06 |
| 69 | TIM4 | 3.000000E-03 | 1.025000E 01 | 4.516602E-02 | 1.113107E-04 | -2.988208E-06 |
| 70 | PW20 | 5.400000E-04 | -1.125750E 03 | -2.523682E 00 | -1.151356E-02 | 8.298680E-04 |
| 71 | ISP2 | 9.400000E-04 | 6.061500E 03 | 1.471045E 01 | 6.235824E-02 | 4.157878E-04 |
| 72 | MFR2 | 10.000000E-03 | 6.575250E 03 | 1.680493E 01 | 7.917192E-02 | -1.579481E-05 |
| 73 | KRP2 | 4.400000E-02 | 1.580000E 02 | -1.264648E-01 | 1.613952E-03 | 6.057524E-04 |
| 74 | DBP2 | 1.000000E-01 | -6.195500E 03 | 5.822510E 00 | -6.504272E-02 | 3.199517E-03 |
| 75 | KRY2 | 2.620000E-02 | 3.250000E 01 | 1.069336E-01 | 3.370271E-04 | 9.523845E-04 |
| 76 | DBY2 | 1.000000E-01 | 3.047500E 02 | 1.239502E 00 | 3.089593E-03 | 1.095050E-02 |
| 77 | ROE2 | 2.500000E-01 | -4.357500E 02 | 6.909180E-02 | -4.473027E-03 | -2.952349E-03 |
| 78 | C2PY | 3.300000E-03 | 1.200000E 01 | 4.272461E-02 | 1.241173E-04 | 3.692571E-04 |
| 79 | C2YP | 3.300000E-03 | 1.350000E 01 | 4.760742E-02 | 1.389517E-04 | 4.046887E-04 |
| 80 | CD02 | 1.000000E-01 | -8.987500E 02 | -2.021729E 00 | -9.184043E-03 | 4.256062E-04 |
| 81 | CNA2 | 1.000000E-01 | -3.130000E 02 | 4.404297E-01 | -3.326089E-03 | 1.406592E-03 |
| 82 | ZET2 | 1.000000E-01 | -1.677500E 02 | 2.873535E-01 | -1.799328E-03 | 1.269135E-03 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 83 | TIM6 | 3.000000E-03 | 1.025000E 01 | 3.662109E-02 | 1.060814E-04 | 3.056510E-04 |
| 84 | TIM7 | 3.000000E-03 | 0. | 0. | 3.201651E-07 | -2.134434E-06 |
| 85 | TMP2 | 1.670000E-03 | -4.872325E 04 | 5.449609E 01 | -5.010121E-01 | 7.167430E-04 |
| 86 | TMY2 | 1.670000E-03 | -2.346750E 03 | -5.406982E 00 | -2.356405E-02 | -4.371108E-02 |
| 87 | PW30 | 6.000000E-04 | 1.291500E 03 | -1.466309E 00 | 1.369175E-02 | 5.378774E-05 |
| 88 | ISP3 | 1.400000E-03 | 8.177500E 03 | 2.736597E 01 | 8.991965E-02 | -3.513279E-04 |
| 89 | MFR3 | 1.800000E-02 | 7.296000E 03 | 2.457471E 01 | 6.177714E-02 | -4.550613E-04 |
| 90 | KRP3 | 4.400000E-02 | 0. | 0. | 0. | -2.134434E-06 |
| 91 | DBP3 | 1.000000E-01 | 0. | 0. | 0. | -2.134434E-06 |
| 92 | KRY3 | 2.100000E-02 | 0. | 0. | 0. | -2.134434E-06 |
| 93 | DBY3 | 1.000000E-01 | 0. | 0. | 0. | -2.134434E-06 |
| 94 | ROE3 | 2.500000E-01 | -3.850000E 01 | -1.630859E-01 | -4.205902E-04 | -8.729835E-04 |
| 95 | TMP3 | 5.570000E-04 | 1.398925E 04 | 4.230102E 01 | 1.577611E-01 | -8.537736E-07 |
| 96 | TMY3 | 5.570000E-04 | 5.797500E 02 | -6.955566E-01 | 6.008112E-03 | -1.033834E-02 |
| 97 | PW40 | 3.400000E-04 | 1.250000E 00 | -3.624023E 00 | 1.898259E-03 | -1.186745E-04 |
| 98 | ISP4 | 6.000000E-03 | 5.275000E 01 | 1.497720E 02 | -4.123364E-02 | 1.562406E-03 |
| 99 | MFR4 | 1.800000E-02 | 6.600000E 01 | 9.834473E 00 | 1.631401E-02 | 2.557052E-04 |
| 100 | TMP4 | 5.000000E-04 | 6.900000E 01 | 2.060059E 00 | 1.954160E-02 | -1.306274E-03 |
| 101 | TMY4 | 5.000000E-04 | 6.450000E 01 | 1.448975E 00 | 1.701752E-02 | 1.519290E-03 |
| 102 | W4CP | 3.000000E-02 | -3.285000E 02 | -1.728101E 01 | -8.635611E-02 | 6.828695E-02 |
| 103 | W4CY | 3.000000E-02 | -2.851750E 03 | 7.255347E 01 | 8.055149E-01 | 6.863059E-03 |

TABLE 18. INDIVIDUAL THREE SIGMA ERROR SOURCE CONTRIBUTIONS AT FIFTH STAGE BURNOUT

| CODE | STND.DEV. | RANGE DEVIATION (FT) | VELOCITY DEV. (FPS) | FLT. PATH ANGLE DEV. (DEG) | INCL.DEV. (DEG) |
|---|---|---|---|---|---|
| 1 PWLO | 6.000000E-04 | 1.616000E 03 | 1.059570E 00 | 1.032789E-02 | 4.738444E-05 |
| 2 SIW1 | 8.300000E-03 | 8.720250E 03 | 4.848633E 00 | 5.577223E-02 | 2.834528E-04 |
| 3 SIW2 | 4.100000E-03 | 2.875500E 03 | 1.596191E 00 | 1.839285E-02 | 9.306133E-05 |
| 4 SIW3 | 9.300000E-04 | 1.046250E 03 | 5.795898E-01 | 6.692091E-03 | 3.372406E-05 |
| 5 SIW4 | 2.400000E-03 | 2.140000E 02 | 1.186523E-01 | 1.366892E-03 | 5.549529E-06 |
| 6 ISP1 | 1.800000E-03 | 1.597300E 04 | 1.807666E 01 | 1.059411E-01 | -4.892123E-04 |
| 7 MFR1 | 1.400000E-02 | 1.830400E 04 | 1.970557E 01 | 1.056205E-01 | -3.602925E-04 |
| 8 KRIA | 1.030000E-07 | 7.250000E 00 | 1.757813E-02 | 4.823821E-05 | 2.283844E-04 |
| 9 KPSA | 1.080000E-07 | 1.405000E 02 | -3.149414E-01 | 8.499316E-04 | 4.268868E-06 |
| 10 KYIA | 1.030000E-07 | 7.250000E 00 | 1.953125E-02 | 3.351061E-05 | -4.414010E-04 |
| 11 THOR | 9.250000E-05 | 9.500000E 00 | 2.343750E-02 | 4.503656E-05 | -4.947618E-04 |
| 12 THOP | 5.760000E-05 | 1.562500E 02 | 6.528320E-01 | 1.269135E-03 | -6.403302E-06 |
| 13 THOY | 5.430000E-05 | 1.200000E 01 | 2.392578E-02 | 6.189859E-05 | -4.200566E-04 |
| 14 DTER | 3.280000E-06 | 5.000000E 00 | 1.220703E-02 | 2.262500E-05 | -2.817453E-04 |
| 15 DTEP | 1.250000E-06 | 1.340000E 02 | 5.390625E-01 | 1.068711E-03 | -5.122642E-06 |
| 16 DTEY | 2.000000E-06 | 1.225000E 01 | 3.125000E-02 | 5.698939E-05 | -6.740543E-04 |
| 17 DKSG | 3.500000E-03 | 6.156500E 03 | 2.436328E 01 | 4.902187E-02 | -1.912453E-04 |
| 18 DRBE | 3.570000E-03 | 1.417500E 02 | 3.437500E-01 | 9.643373E-04 | 4.317960E-03 |
| 19 DYBE | 3.570000E-03 | 1.730000E 02 | 4.902344E-01 | 1.179061E-03 | 6.354637E-03 |
| 20 DPBE | 3.570000E-03 | 3.738250E 03 | -9.109375E 00 | 2.231316E-02 | 1.404458E-04 |
| 21 TYRG | 1.450000E-03 | 2.250000E 00 | 5.371094E-03 | 1.003184E-05 | -1.045873E-04 |
| 22 TRRG | 1.450000E-03 | 0. | 0. | 0. | 0. |
| 23 KPP1 | 2.430000E-02 | 6.975000E 01 | 4.448242E-01 | 7.095926E-04 | -6.830189E-06 |
| 24 KPR1 | 3.060000E-02 | 0. | 0. | 0. | 0. |
| 25 KPY1 | 2.330000E-02 | 1.250000E 00 | 3.417969E-03 | 8.431015E-06 | 4.653066E-05 |
| 26 KRP1 | 4.400000E-02 | 4.755000E 02 | -1.155273E 00 | 2.813184E-03 | 1.835613E-05 |
| 27 KRY1 | 2.100000E-02 | 0. | 0. | 0. | 0. |
| 28 KRR1 | 2.620000E-02 | 0. | 0. | 0. | 0. |
| 29 KPAN | 3.130000E-11 | 3.000000E 00 | 1.123047E-02 | 2.241156E-05 | -4.268868E-07 |
| 30 KRAN | 3.120000E-11 | 0. | 0. | 1.067217E-07 | 3.415095E-06 |
| 31 KYAN | 3.130000E-11 | 0. | 0. | 5.336085E-07 | 4.695755E-06 |
| 32 TMP1 | 1.670000E-03 | 1.474125E 04 | -6.543896E 01 | 8.258467E-02 | 1.144484E-03 |
| 33 TMY1 | 1.670000E-03 | 6.895500E 03 | 6.252930E 00 | 4.491991E-02 | 6.392246E-02 |
| 34 CA01 | 10.000000E-03 | 6.615750E 03 | 3.354980E 00 | 4.239509E-02 | 2.130165E-04 |
| 35 CNAL | 2.000000E-01 | 3.288750E 03 | -5.574707E 00 | 1.997873E-02 | 7.129010E-05 |
| 36 CNDQ | 2.000000E-01 | -4.030000E 02 | 6.293945E-01 | -2.442326E-03 | -8.537736E-06 |
| 37 CYBA | 3.300000E-01 | 4.475000E 01 | 8.496094E-02 | 2.997813E-04 | 7.863255E-04 |
| 38 CYDR | 3.300000E-01 | -7.500000E 00 | 9.765625E-04 | -5.261380E-05 | -1.976486E-04 |
| 39 CLDP | 1.000000E-01 | 0. | 0. | 0. | 0. |
| 40 CLP1 | 1.000000E-01 | 0. | 0. | 0. | 0. |
| 41 CMDQ | 2.000000E-03 | 1.300000E 01 | 4.589844E-02 | 6.211203E-05 | 0. |

| | | | | | |
|---|---|---|---|---|---|
| 42 CMQ1 | 2.000000E-03 | 3.500000E 00 | 1.318359E-02 | 1.494104E-05 | 0. |
| 43 CMAL | 2.000000E-03 | 2.375000E 01 | 6.835938E-02 | 1.742765E-04 | -1.707547E-06 |
| 44 CMQ1 | 9.000000E-02 | 2.305500E 03 | -5.790527E 00 | 1.383796E-02 | 8.793868E-05 |
| 45 NCBA | 3.300000E-01 | -7.775000E 01 | -1.269531E-01 | -5.180272E-04 | -1.475321E-03 |
| 46 NCDR | 3.300000E-01 | 2.350000E 01 | 4.199219E-02 | 1.581616E-04 | 3.265684E-04 |
| 47 NCR1 | 3.300000E-01 | 0. | 0. | 8.537736E-07 | 4.268868E-07 |
| 48 DRHO | 6.670000E-02 | 4.218700E 04 | 1.475098E 01 | 2.673175E-01 | 1.844151E-03 |
| 49 FWN1 | 1.000000E 00 | 7.275000E 01 | 1.208984E 00 | 1.805731E-03 | 1.792114E-02 |
| 50 CNDR | 5.760000E-05 | 3.500000E 00 | 1.269531E-02 | 2.764092E-05 | -4.268868E-07 |
| 51 CYDQ | 5.760000E-05 | 5.000000E-01 | 4.882813E-04 | 2.134434E-06 | -1.024528E-05 |
| 52 CLDR | 5.760000E-05 | 0. | 0. | 5.336085E-07 | 2.561321E-06 |
| 53 CLDQ | 5.760000E-05 | 7.500000E-01 | 1.464844E-03 | 4.589033E-06 | 2.433255E-05 |
| 54 CMDR | 5.760000E-05 | 0. | 0. | 3.201651E-07 | 0. |
| 55 NCDQ | 5.760000E-05 | 0. | 0. | -1.067217E-07 | 0. |
| 56 LSMY | 10.000000E-03 | 1.275000E 01 | 2.099609E-02 | 7.523880E-05 | -1.933797E-04 |
| 57 LSMP | 10.000000E-03 | 1.657500E 02 | 4.101563E-02 | 1.062628E-03 | -4.324363E-04 |
| 58 MSMP | 1.000000E-01 | 2.830000E 02 | -5.380859E-01 | 1.727718E-03 | 7.257076E-06 |
| 59 MSMR | 1.000000E-01 | 2.881250E 03 | -5.789063E 00 | 1.756874E-02 | 8.196227E-05 |
| 60 NSMY | 1.000000E-01 | -4.000000E 00 | 9.765625E-04 | -2.870814E-05 | -1.084293E-04 |
| 61 NSMR | 1.000000E-01 | 9.550000E 01 | 3.310547E-01 | 6.598603E-04 | 5.004394E-03 |
| 62 CDV1 | 1.000000E-01 | -4.567000E 03 | -5.139160E 00 | -3.034557E-02 | 1.387382E-04 |
| 63 CDV2 | 1.000000E-01 | -2.167000E 03 | -2.448242E 00 | -1.440188E-02 | 6.702123E-05 |
| 64 CDV3 | 1.000000E-01 | -2.167000E 03 | -2.448242E 00 | -1.440188E-02 | 6.702123E-05 |
| 65 LDA2 | 1.000000E-01 | 5.272500E 02 | -1.992188E-01 | 3.348393E-03 | 8.921934E-05 |
| 66 TIM1 | 7.800000E-02 | 1.234325E 04 | -2.895996E 01 | 7.393263E-02 | 4.418279E-04 |
| 67 TIM2 | 4.000000E-03 | 5.142500E 02 | 2.024414E 00 | 4.097900E-03 | -1.707547E-05 |
| 68 TIM3 | 3.000000E-03 | 2.250000E 01 | 9.033203E-02 | 1.779051E-04 | -1.707547E-06 |
| 69 TIM4 | 3.000000E-03 | 1.100000E 01 | 4.492188E-02 | 8.793868E-05 | -4.268868E-07 |
| 70 PW20 | 5.400000E-04 | -1.187750E 03 | -2.501953E 00 | -8.668470E-03 | 1.048007E-03 |
| 71 ISP2 | 9.400000E-04 | 6.401250E 03 | 1.457861E 01 | 4.710888E-02 | 5.276321E-04 |
| 72 MFR2 | 10.000000E-03 | 7.002250E 03 | 1.663232E 01 | 5.960482E-02 | 1.404458E-04 |
| 73 KRP2 | 4.400000E-02 | 1.657500E 02 | -1.298828E-01 | 1.129116E-03 | 7.641274E-04 |
| 74 DBP2 | 1.000000E-01 | -6.496500E 03 | 5.912109E 00 | -4.548009E-02 | 4.028531E-03 |
| 75 KRY2 | 2.620000E-02 | 3.450000E 01 | 1.044922E-01 | 2.588001E-04 | 1.199979E-03 |
| 76 DBY2 | 1.000000E-01 | 3.227500E 02 | 1.208984E 00 | 2.412337E-03 | 1.367190E-02 |
| 77 ROE2 | 2.500000E-01 | -4.572500E 02 | 7.958984E-02 | -3.182548E-03 | -3.690863E-03 |
| 78 C2PY | 3.300000E-03 | 1.275000E 01 | 4.150391E-02 | 9.583609E-05 | 4.682948E-04 |
| 79 C2YP | 3.300000E-03 | 1.425000E 01 | 4.638672E-02 | 1.072553E-04 | 5.114104E-04 |
| 80 CDO2 | 1.000000E-01 | -9.482500E 02 | -2.003906E 00 | -6.915993E-03 | 5.370236E-04 |
| 81 CNA2 | 1.000000E-01 | -3.277500E 02 | 4.428711E-01 | -2.305509E-03 | 1.762616E-03 |
| 82 ZET2 | 1.000000E-01 | -1.757500E 02 | 2.880859E-01 | -1.239893E-03 | 1.589300E-03 |
| 83 TIM6 | 3.000000E-03 | 1.075000E 01 | 3.613281E-02 | 8.174883E-05 | 3.884670E-04 |
| 84 TIM7 | 3.000000E-03 | 0. | 0. | 1.067217E-07 | 0. |
| 85 TMP2 | 1.670000E-03 | -5.102350E 04 | 5.489697E 01 | -3.487786E-01 | 9.361628E-04 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 86 | TMY2 | 1.670000E-03 | -2.474500E 03 | -5.437500E 00 | -1.779798E-02 | -5.538472E-02 |
| 87 | PW30 | 6.000000E-04 | 1.354250E 03 | -1.487793E 00 | 9.547430E-03 | 7.129010E-05 |
| 88 | ISP3 | 1.400000E-03 | 8.682250E 03 | 2.716650E 01 | 6.867104E-02 | -4.589033E-04 |
| 89 | MFR3 | 1.800000E-02 | 7.656250E 03 | 2.444336E 01 | 4.782530E-02 | -4.930543E-04 |
| 90 | KRP3 | 4.400000E-02 | 0. | 0. | 0. | 0. |
| 91 | DBP3 | 1.000000E-01 | 0. | 0. | 0. | 0. |
| 92 | KRY3 | 2.100000E-02 | 0. | 0. | 0. | 0. |
| 93 | DBY3 | 1.000000E-01 | 0. | 0. | 0. | 0. |
| 94 | ROE3 | 2.500000E-01 | -4.075000E 01 | -1.606445E-01 | -3.264617E-04 | -1.152594E-03 |
| 95 | TMP3 | 5.570000E-04 | 1.486050E 04 | 4.194727E 01 | 1.193992E-01 | 4.695755E-06 |
| 96 | TMY3 | 5.570000E-04 | 6.072500E 02 | -6.987305E-01 | 4.183384E-03 | -1.365654E-02 |
| 97 | PW40 | 3.400000E-04 | 2.000000E 00 | -4.647461E 00 | 1.844578E-03 | -1.391651E-04 |
| 98 | ISP4 | 6.000000E-03 | 1.650000E 02 | 1.498555E 02 | -2.453575E-02 | 1.078743E-03 |
| 99 | MFR4 | 1.800000E-02 | 1.667500E 02 | 9.795410E 00 | 1.227011E-02 | 1.553868E-04 |
| 100 | TMP4 | 5.000000E-04 | 1.690000E 02 | 2.011230E 00 | 1.428385E-02 | -9.037194E-04 |
| 101 | TMY4 | 5.000000E-04 | 1.510000E 02 | 1.411621E 00 | 1.242486E-02 | 1.054837E-03 |
| 102 | W4CP | 3.000000E-02 | -7.870000E 02 | -1.740967E 01 | -6.332770E-02 | 4.676716E-02 |
| 103 | W4CY | 3.000000E-02 | 1.243000E 03 | 6.987598E 01 | 5.886191E-01 | 4.754665E-03 |
| 104 | PW50 | 3.333000E-04 | -6.250000E 00 | -5.453613E 00 | -2.027712E-04 | -2.134434E-06 |
| 105 | SIW5 | 3.333000E-04 | -4.250000E 00 | -5.179199E 00 | -1.716085E-04 | -1.707547E-06 |
| 106 | MFR5 | 1.800000E-02 | 7.775000E 01 | -5.266406E 01 | -1.053953E-01 | -1.425802E-04 |
| 107 | ISP5 | 1.533300E-03 | 4.875000E 01 | 4.894092E 01 | 1.719607E-03 | 7.257076E-06 |
| 108 | TMP5 | 6.666000E-04 | 2.925000E 01 | -2.740723E 00 | 1.636844E-02 | 2.629623E-04 |
| 109 | TMY5 | 6.666000E-04 | -1.150000E 01 | -9.379883E-01 | 1.443731E-03 | -2.054606E-03 |
| 110 | W5CP | 4.633300E-02 | -1.500000E 01 | -1.977344E 01 | -3.086392E-04 | 7.196799E-02 |
| 111 | W5CY | 4.633300E-02 | 1.938000E 03 | -2.571143E 01 | 5.725628E-01 | -3.457783E-05 |

TABLE 19. DATA FROM NON-LINEAR CARDS

| CODE | STND.DEV. | POSITION DEVIATIONS | | | VELOCITY DEVIATIONS | | |
|---|---|---|---|---|---|---|---|
| MP1 | 1.670000E-03 | | | | | | |
| | | 1.473200E 04 | -1.980500E 04 | 5.874600E 02 | 7.698900E 01 | -8.299600E 01 | 2.375100E 00 |
| | | 9.821600E 03 | -1.320400E 04 | 3.916400E 02 | 5.132600E 01 | -5.533100E 01 | 1.583400E 00 |
| | | 4.910800E 03 | -6.601800E 03 | 1.958200E 02 | 2.566300E 01 | -2.766500E 01 | 7.917100E-01 |
| | | 4.172800E 03 | -6.638000E 03 | 2.092600E 02 | 2.229600E 01 | -2.777000E 01 | 8.541400E-01 |
| | | 8.345700E 03 | -1.327600E 04 | 4.185400E 02 | 4.459100E 01 | -5.553900E 01 | 1.708300E 00 |
| | | 1.251900E 04 | -1.991400E 04 | 6.278000E 02 | 6.690500E 01 | -8.330900E 01 | 2.562400E 00 |
| MY1 | 1.670000E-03 | | | | | | |
| | | 6.888100E 03 | -1.463400E 02 | 1.782300E 04 | 3.169600E 01 | -3.187000E-01 | -8.302500E 01 |
| | | 4.592000E 03 | -9.755700E 01 | 1.188100E 04 | 2.113100E 01 | -2.124700E-01 | -5.535000E 01 |
| | | 2.296000E 03 | -4.877800E 01 | 5.940300E 03 | 1.056500E 01 | -1.062300E-01 | -2.767500E 01 |
| | | -2.283800E 03 | 3.153300E 01 | 6.643200E 03 | -1.051700E 01 | 2.406500E-01 | 2.816200E 01 |
| | | -4.567700E 03 | 6.306600E 01 | 1.328600E 04 | -2.103300E 01 | 4.812900E-01 | 5.632300E 01 |
| | | -6.851600E 03 | 9.460100E 01 | 1.993000E 04 | -3.155000E 01 | 7.219500E-01 | 8.448400E 01 |
| MP2 | 1.670000E-03 | | | | | | |
| | | -5.103400E 04 | 2.129700E 04 | 5.695800E 02 | -2.609500E 02 | 1.094400E 02 | 3.214400E 00 |
| | | -3.519100E 04 | 1.485500E 04 | 3.942500E 02 | -1.903500E 02 | 6.896000E 01 | 2.271100E 00 |
| | | -1.714700E 04 | 7.719800E 03 | 2.089100E 02 | -9.499000E 01 | 3.427600E 01 | 1.215700E 00 |
| | | 1.752600E 04 | 7.162400E 03 | 2.069700E 02 | 9.420500E 01 | 3.208500E 01 | 1.132000E 00 |
| | | 3.586300E 04 | 1.406700E 04 | 4.387600E 02 | 1.938800E 02 | 6.398500E 01 | 2.386000E 00 |
| | | 5.238400E 04 | 2.005900E 04 | 6.122700E 02 | 2.702500E 02 | 1.006800E 02 | 3.377600E 00 |
| MY2 | 1.670000E-03 | | | | | | |
| | | -2.499100E 03 | -7.100200E 02 | -3.252600E 04 | -1.201300E 01 | -3.429500E 00 | -1.700500E 02 |
| | | -1.553900E 03 | -4.360700E 02 | -2.324400E 04 | -7.613800E 00 | -2.334000E 00 | -1.282700E 02 |
| | | -8.510200E 02 | -2.195700E 02 | -1.156300E 04 | -4.012900E 00 | -1.197700E 00 | -5.702700E 01 |
| | | -8.162800E 02 | -2.338600E 02 | 1.146300E 04 | -3.846500E 00 | -1.338500E 00 | 5.618200E 01 |
| | | -1.594500E 03 | -4.728700E 02 | 2.283100E 04 | -7.786900E 00 | -2.517700E 00 | 1.140300E 02 |
| | | -2.443900E 03 | -6.607200E 02 | 3.423500E 04 | -1.142100E 01 | -3.727800E 00 | 1.653600E 02 |
| MP3 | 5.570000E-04 | | | | | | |
| | | 1.486000E 04 | 4.499600E 03 | 5.938000E 00 | 8.059400E 01 | 2.598600E 01 | 5.415200E-02 |
| | | 1.176200E 04 | 3.339400E 03 | 3.076900E 01 | 5.693900E 01 | 1.857000E 01 | 3.675500E-02 |
| | | 6.017300E 03 | 1.517500E 03 | 2.207200E 00 | 2.890500E 01 | 9.120800E 00 | 2.050700E-02 |
| | | -5.370700E 03 | 1.652900E 03 | 2.212000E 00 | -2.753100E 01 | 8.898500E 00 | 1.937600E-02 |
| | | -1.074200E 04 | 3.262900E 03 | 2.991800E 01 | -5.504000E 01 | 1.919800E 01 | 4.060600E-02 |
| | | -1.611200E 04 | 4.976800E 03 | 6.518400E 00 | -8.253900E 01 | 2.853000E 01 | 5.644400E-02 |
| MY3 | 5.570000E-04 | | | | | | |
| | | 6.057300E 02 | -2.537000E 02 | -8.560100E 03 | 3.091300E 00 | -1.390900E 00 | -5.027700E 01 |
| | | 4.630400E 02 | -1.324200E 02 | -6.373200E 03 | 2.267800E 00 | -1.234800E-01 | -3.565400E 01 |
| | | 2.327800E 02 | -7.118500E 01 | -3.322100E 03 | 1.187700E 00 | -4.669000E-01 | -1.921100E 01 |
| | | 2.303300E 02 | -8.632500E 01 | 2.857500E 03 | 1.119400E 00 | -4.947400E-01 | 1.718800E 01 |
| | | 4.608800E 02 | -1.641400E 02 | 5.715000E 03 | 2.251700E 00 | -1.390700E-01 | 3.437600E 01 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| W4CP | 3.000000E-02 | | | | | | |
| | | -7.873400E 02 | -1.430000E 02 | -4.478800E 03 | -4.576100E 01 | -9.461500E 00 | -3.019500E 02 |
| | | -5.248900E 02 | -9.533400E 01 | -2.985900E 03 | -3.050700E 01 | -6.307700E 00 | -2.013000E 02 |
| | | -2.624500E 02 | -4.766700E 01 | -1.493000E 03 | -1.525400E 01 | -3.153800E 00 | -1.006500E 02 |
| | | 2.594600E 02 | -2.611900E 01 | 1.464900E 03 | 1.507900E 01 | -1.701200E 00 | 9.791300E 01 |
| | | 5.189300E 02 | -5.223300E 01 | 2.918500E 03 | 3.015800E 01 | -3.401800E 00 | 1.947100E 02 |
| | | 7.785900E 02 | -7.836500E 01 | 4.409500E 03 | 4.523700E 01 | -5.103800E 00 | 2.948600E 02 |
| W4CY | 3.000000E-02 | | | | | | |
| | | 1.243000E 03 | -1.680500E 02 | -4.887600E 02 | 4.090700E 02 | -1.598600E 01 | -3.226700E 01 |
| | | 8.287100E 02 | -1.120300E 02 | -3.258400E 02 | 2.727200E 02 | -1.065700E 01 | -2.151100E 01 |
| | | 4.143200E 02 | -5.601700E 01 | -1.629200E 02 | 1.363500E 02 | -5.328600E 00 | -1.075600E 01 |
| | | -2.313700E 03 | 1.588500E 01 | 1.643800E 02 | -1.366000E 02 | 8.034300E-01 | 1.085200E 01 |
| | | -4.627500E 03 | 3.177000E 01 | 3.287600E 02 | -2.732000E 02 | 1.607000E 00 | 2.170300E 01 |
| | | -6.941300E 03 | 4.765500E 01 | 4.931500E 02 | -4.098000E 02 | 2.410300E 00 | 3.255500E 01 |
| W5CP | 4.633300E-02 | | | | | | |
| | | -1.504100E 01 | -9.728700E 01 | -2.005700E 03 | -4.103100E 00 | -2.134900E 01 | -3.922600E 02 |
| | | -1.051900E 01 | -6.483700E 01 | -1.379500E 03 | -2.750000E 00 | -1.534800E 01 | -2.600500E 02 |
| | | -5.026300E 00 | -3.241100E 01 | -6.672100E 02 | -1.371700E 00 | -7.163900E 00 | -1.314800E 02 |
| | | -9.452700E 00 | -3.132500E 01 | 7.043200E 02 | -1.843200E 00 | -7.002700E 00 | 1.365500E 02 |
| | | -1.892700E 01 | -6.264500E 01 | 1.483700E 03 | -3.701500E 00 | -1.425800E 01 | 2.733000E 02 |
| | | -2.834300E 01 | -9.386600E 01 | 2.094200E 03 | -5.524600E 00 | -2.094300E 01 | 4.095400E 02 |
| W5CY | 4.633300E-02 | | | | | | |
| | | 1.938000E 03 | -5.351700E 02 | 5.011300E 00 | 3.785400E 02 | -1.071400E 02 | 2.519300E-01 |
| | | 1.293100E 03 | -3.574400E 02 | 3.352100E 00 | 2.701500E 02 | -7.150000E 01 | 1.672100E-01 |
| | | 6.451100E 02 | -1.782700E 02 | 1.677700E 00 | 1.263100E 02 | -3.577700E 01 | 8.311200E-02 |
| | | -7.113500E 02 | 1.211100E 02 | -1.713000E 00 | -1.352100E 02 | 2.288800E 01 | -1.009100E-01 |
| | | -1.422800E 03 | 2.422200E 02 | -3.422200E 00 | -2.718800E 02 | 4.909900E 01 | -1.932700E-01 |
| | | -2.067500E 03 | 3.631100E 02 | -5.135600E 00 | -4.050600E 02 | 6.858300E 01 | -2.896700E-01 |

TABLE 20. DATA FROM CROSS TERM CARDS

```
CODE1 CODE2 STND.DEV.1   STND.DEV.2
                     6 CRUSS TERMS
DBY2     TMY2     1.000000E-01  1.670000E-03
-1.572941E 06 -5.846307E 05  1.123007E 07 -7.500399E 03 -2.564118E 03 -2.001697E 05
TMY2     KRY2     1.670000E-03  2.620000E-02
-6.702432E 06 -3.163368E 05 -1.135248E 08 -3.324585E 04 -6.130411E 02 -5.842889E 05
ROE2     TMY2     2.500000E-01  1.670000E-03
-4.419215E 05 -1.776820E 05 -1.175686E 07 -2.125775E 03 -8.630153E 02 -6.045216E 04
DBP2     TMP2     1.000000E-01  1.670000E-03
-4.528290E 07  9.897472E 06  4.854491E 05 -2.365675E 05  5.135729E 04  1.465070E 03
TMP2     KRP2     1.670000E-03  4.400000E-02
-1.031569E 08  2.114089E C7 -2.080536E 05 -5.343918E 05  1.157874E 05 -9.263292E 02
ROE2     TMP2     2.500000E-01  1.670000E-03
-1.823518E 07  3.758744E 06 -2.125003E 05 -9.390768E 04  2.087678E 04 -1.399335E 03
DBY3     TMY3     1.000000E-01  5.570000E-04
 1.613944E 06 -6.743766E 05 -3.377718E 07  8.098344E 03 -3.662797E 03 -2.127668E 05
TMY3     KRY3     5.570000E-04  2.100000E-02
-7.999487E 06 -1.408766E 06 -1.082851E 08 -4.033513E 04 -7.590360E 03 -6.398792E 05
ROE3     TMY3     2.500000E-01  5.570000E-04
 3.268582E 05 -1.341033E 05 -9.133214E 06  1.738703E 03 -6.248554E 02 -5.471462E 04
DBP3     TMP3     1.000000E-01  5.570000E-04
 5.899003E 07  1.114562E 07  1.682226E 04  3.220048E C5  6.536705E 04  1.496369E 02
TMP3     KRP3     5.570000E-04  4.400000E-02
-4.085877E 07  1.443655E 07  1.729478E 04 -2.286828E 05  8.558788E C4  1.625517E 02
ROE3     TMP3     2.500000E-01  5.570000E-04
 1.623425E 07  2.306507E 06 -3.496508E 03  8.783748E 04  1.361776E 04 -1.753522E 01
```

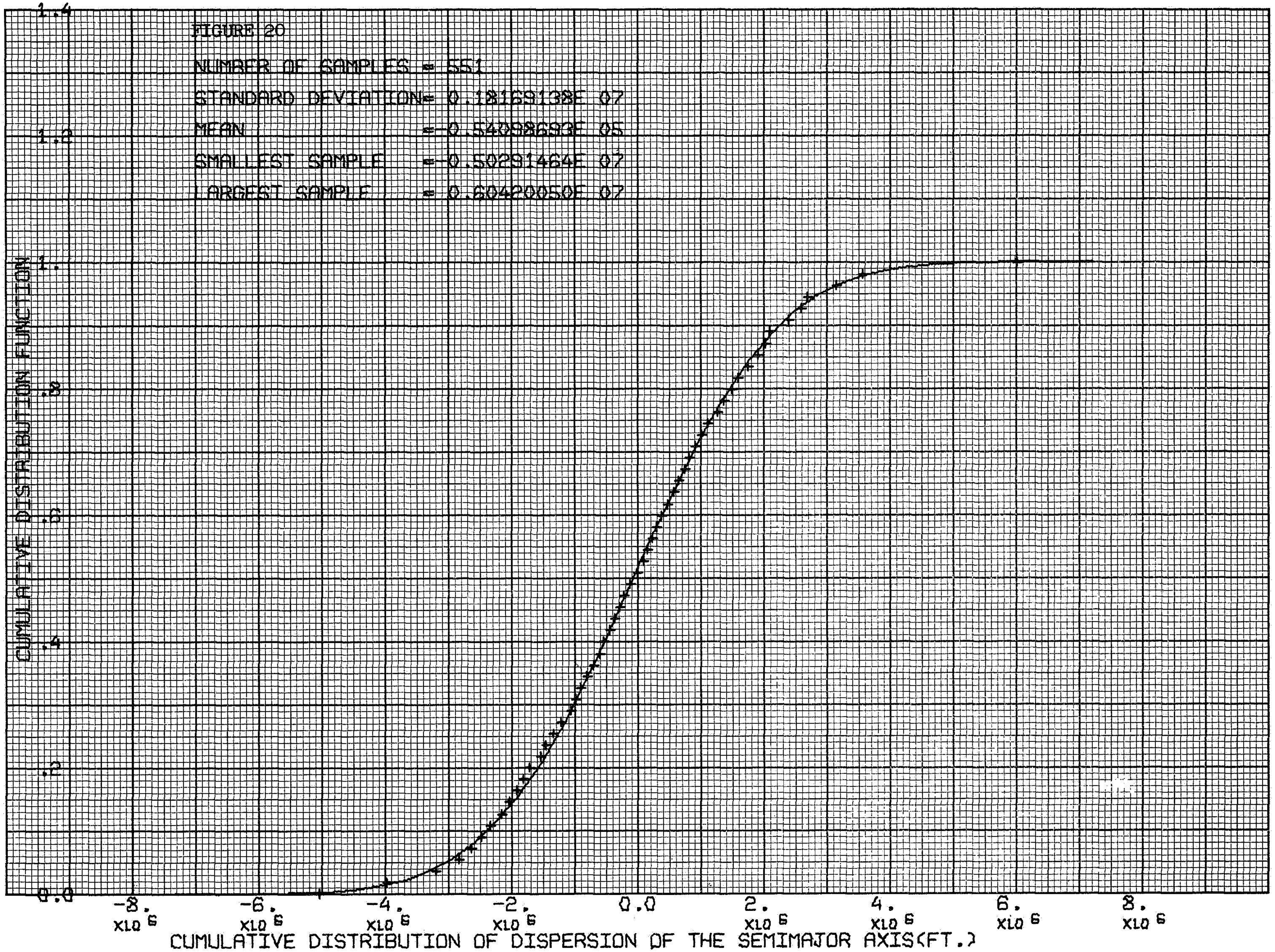


FIGURE 20
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.18169138E 07
MEAN = -0.54098693E 05
SMALLEST SAMPLE = -0.50291464E 07
LARGEST SAMPLE = 0.60420050E 07
CUMULATIVE DISTRIBUTION FUNCTION
0.0
.2
.4
.6
.8
1.
1.2
1.4
-8. X10 6
-6. X10 6
-4. X10 6
-2. X10 6
0.0
2. X10 6
4. X10 6
6. X10 6
8. X10 6
CUMULATIVE DISTRIBUTION OF DISPERSION OF THE SEMIMAJOR AXIS(FT.)

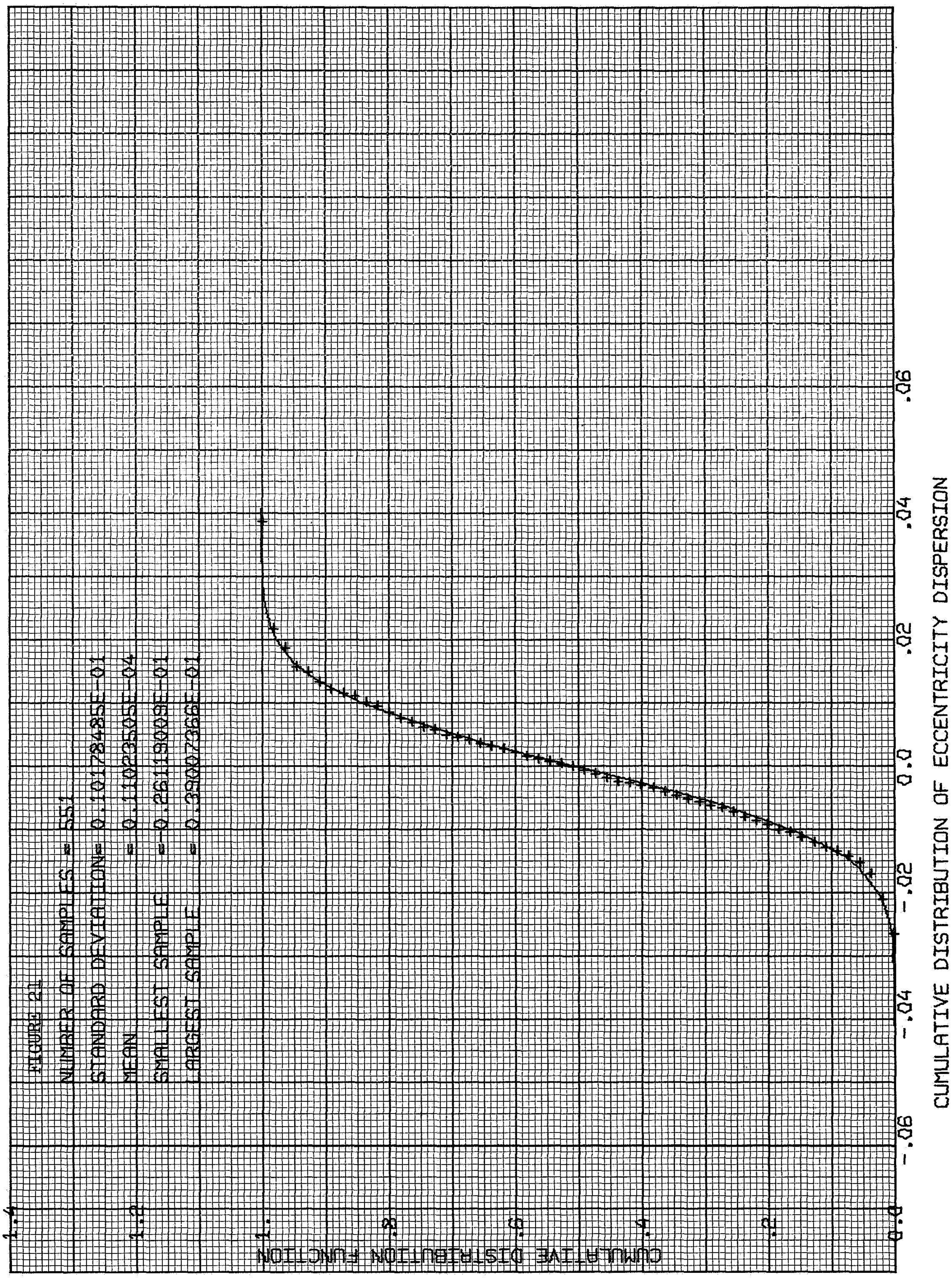


FIGURE 21
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.10178485E-01
MEAN = 0.11023505E-04
SMALLEST SAMPLE =-0.26119009E-01
LARGEST SAMPLE = 0.39007366E-01
CUMULATIVE DISTRIBUTION FUNCTION
CUMULATIVE DISTRIBUTION OF ECCENTRICITY DISPERSION
0.0
.2
.4
.6
.8
1.
1.2
1.4
-.06
-.04
-.02
0.0
.02
.04
.06

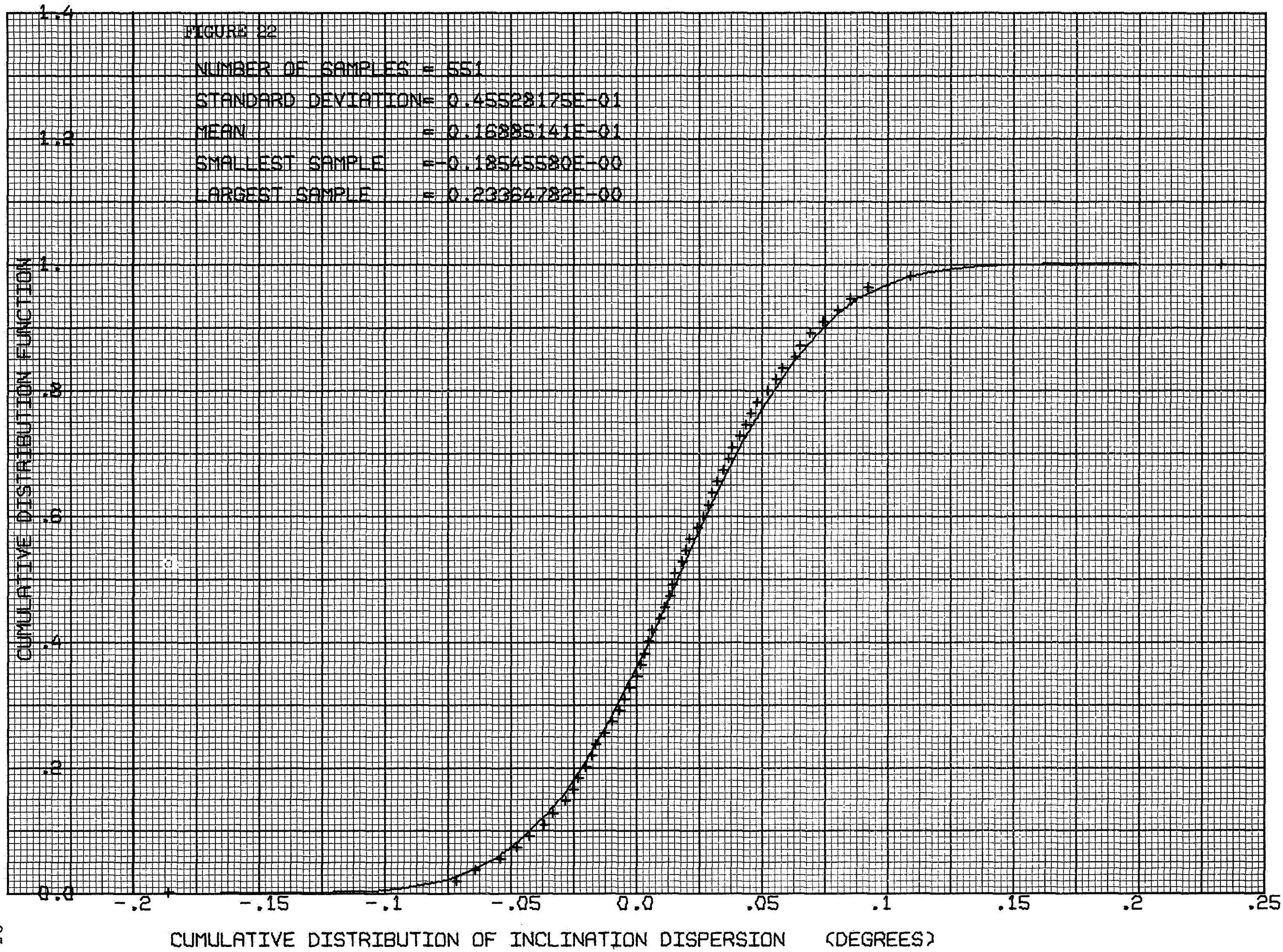


FIGURE 22
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.45528175E-01
MEAN = 0.16885141E-01
SMALLEST SAMPLE =-0.18545580E-00
LARGEST SAMPLE = 0.23364782E-00
CUMULATIVE DISTRIBUTION FUNCTION
0.0
.2
.4
.6
.8
1.
1.2
1.4
-.2
-.15
-.1
-.05
0.0
.05
.1
.15
.2
.25
CUMULATIVE DISTRIBUTION OF INCLINATION DISPERSION (DEGREES)

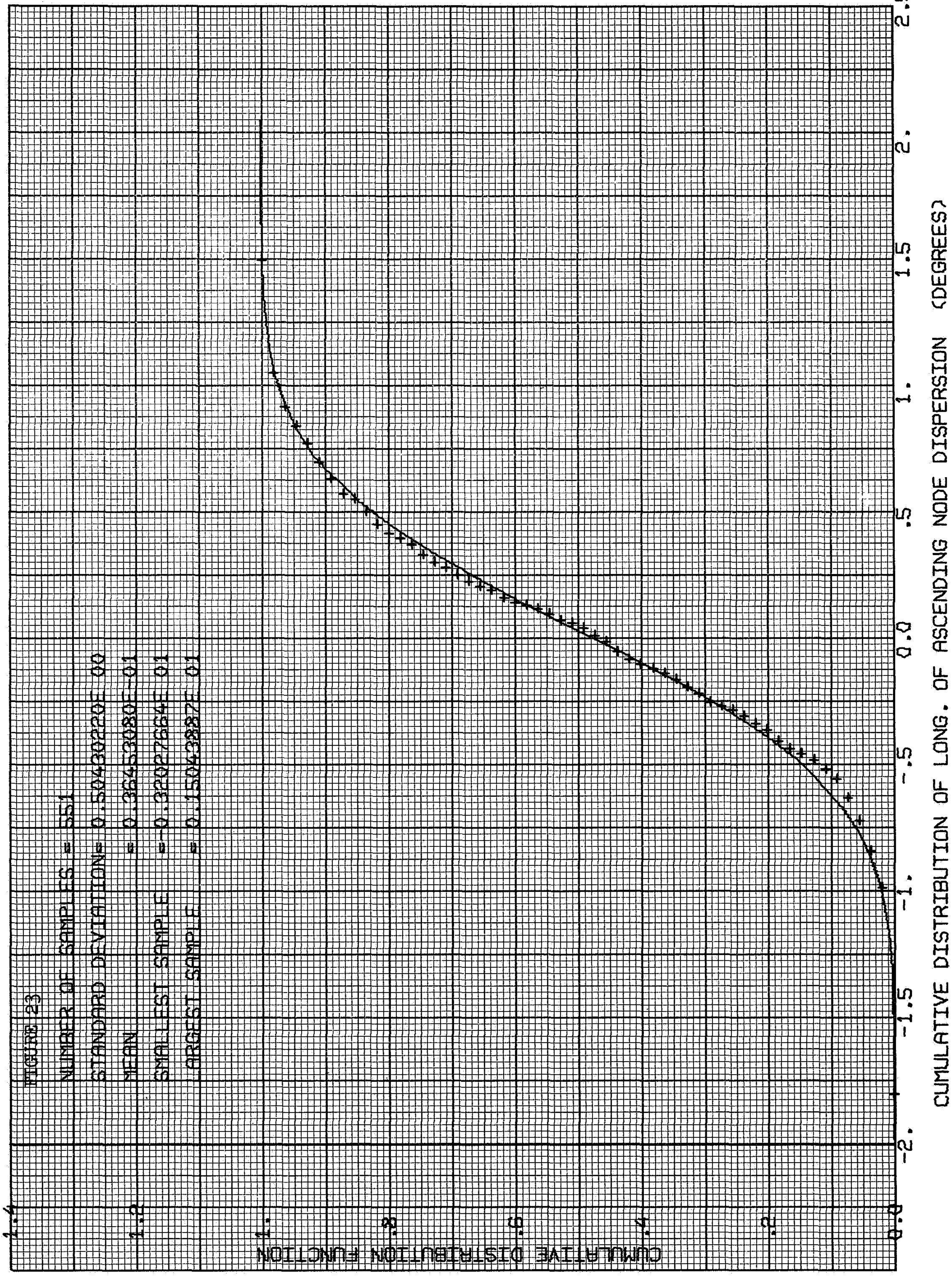


FIGURE 23
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.50430220E 00
MEAN = 0.36453080E-01
SMALLEST SAMPLE = -0.32027664E 01
LARGEST SAMPLE = 0.15043887E 01
CUMULATIVE DISTRIBUTION FUNCTION
CUMULATIVE DISTRIBUTION OF LONG. OF ASCENDING NODE DISPERSION (DEGREES)
0.0
.2
.4
.6
.8
1.
1.2
1.4
-2.
-1.5
-1.
-.5
0.0
.5
1.
1.5
2.
2.5

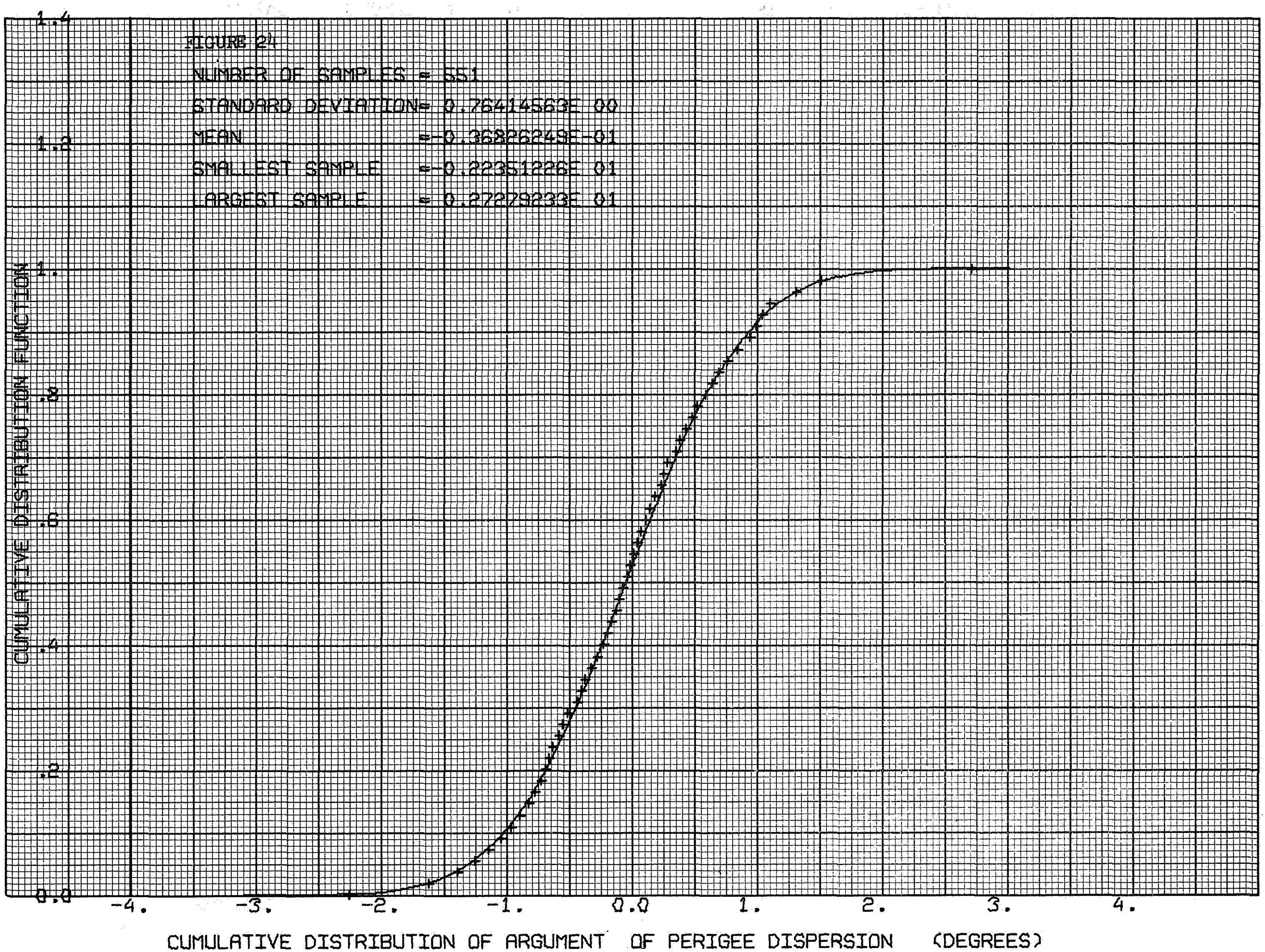


FIGURE 24
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.76414563E 00
MEAN = -0.36826249E-01
SMALLEST SAMPLE = -0.22351226E 01
LARGEST SAMPLE = 0.27279233E 01
1.4
1.2
1.
.8
.6
.4
.2
0.0
-4.
-3.
-2.
-1.
0.0
1.
2.
3.
4.
CUMULATIVE DISTRIBUTION FUNCTION
CUMULATIVE DISTRIBUTION OF ARGUMENT OF PERIGEE DISPERSION (DEGREES)

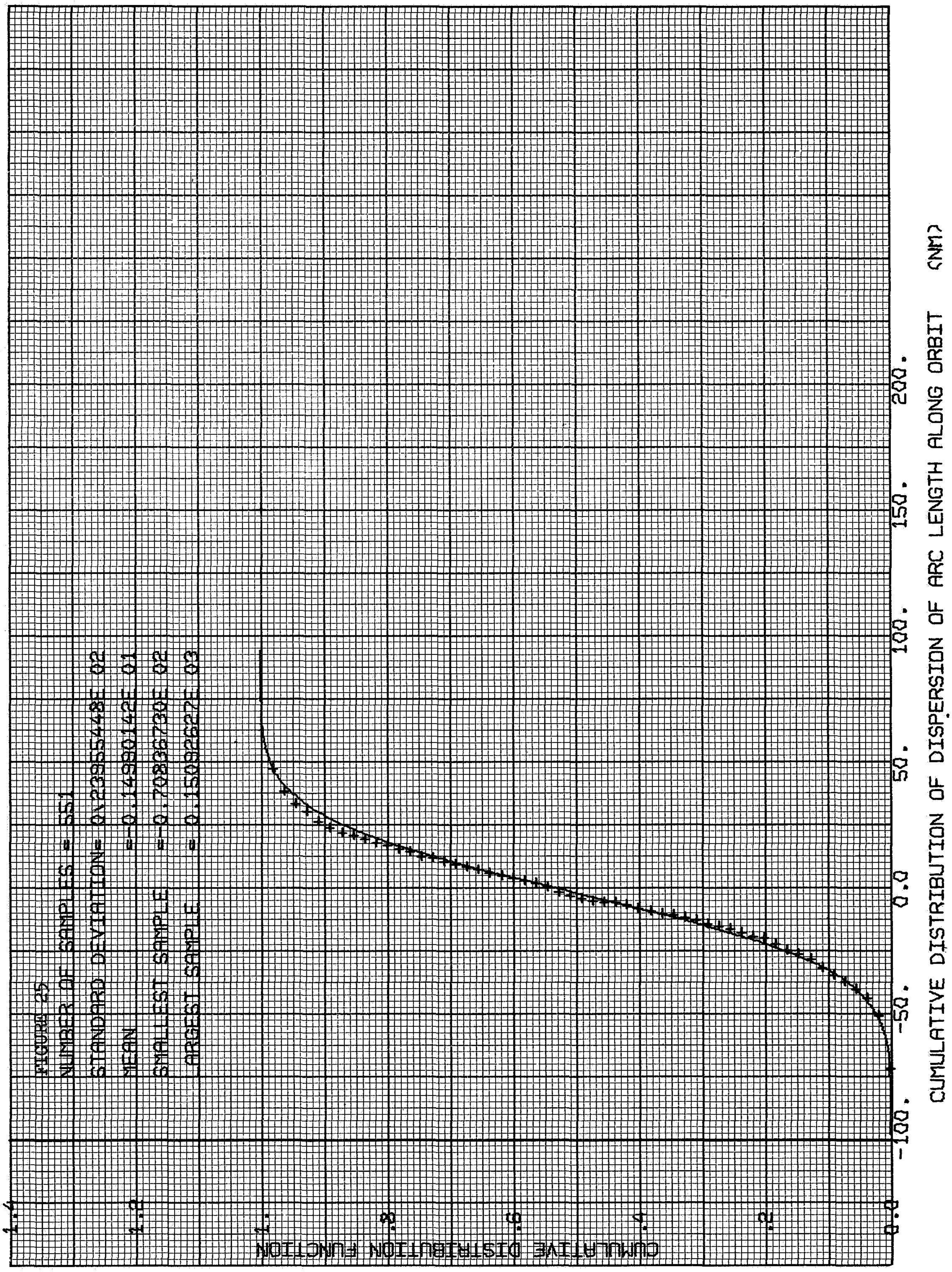


FIGURE 25
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.23955448E 02
MEAN =-0.14980142E 01
SMALLEST SAMPLE =-0.70836730E 02
ARGEST SAMPLE = 0.15082627E 03
CUMULATIVE DISTRIBUTION FUNCTION
0.0
.2
.4
.6
.8
1.
1.2
1.4
-100.
-50.
0.0
50.
100.
150.
200.
CUMULATIVE DISTRIBUTION OF DISPERSION OF ARC LENGTH ALONG ORBIT (NM)

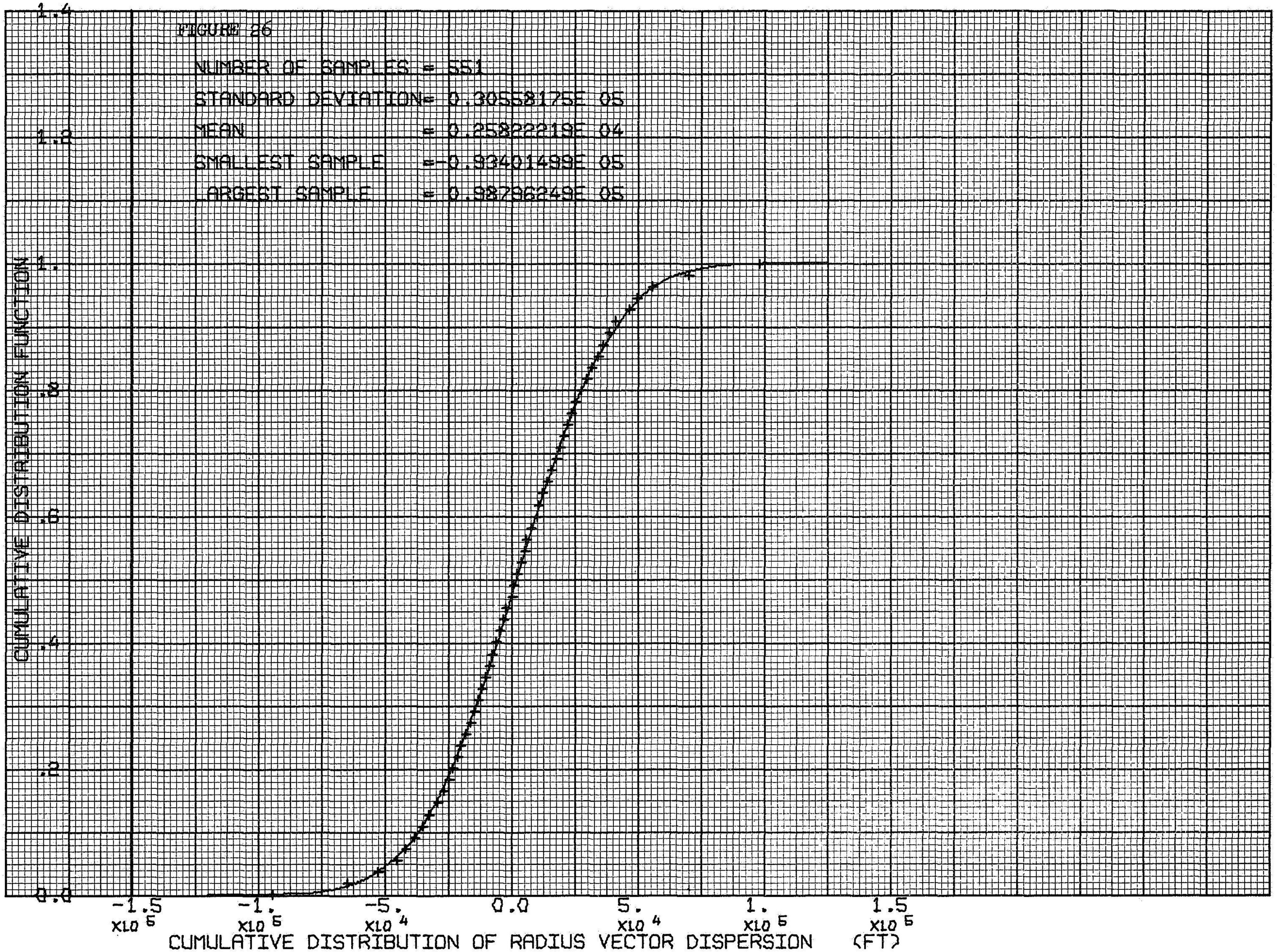


FIGURE 26
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.30558175E 05
MEAN = 0.25822219E 04
SMALLEST SAMPLE =-0.93401499E 05
LARGEST SAMPLE = 0.98796249E 05
CUMULATIVE DISTRIBUTION FUNCTION
0.0
.2
.4
.6
.8
1.
1.2
1.4
-1.5 X10 5
-1. X10 5
-5. X10 4
0.0
5. X10 4
1. X10 5
1.5 X10 5
CUMULATIVE DISTRIBUTION OF RADIUS VECTOR DISPERSION (FT)

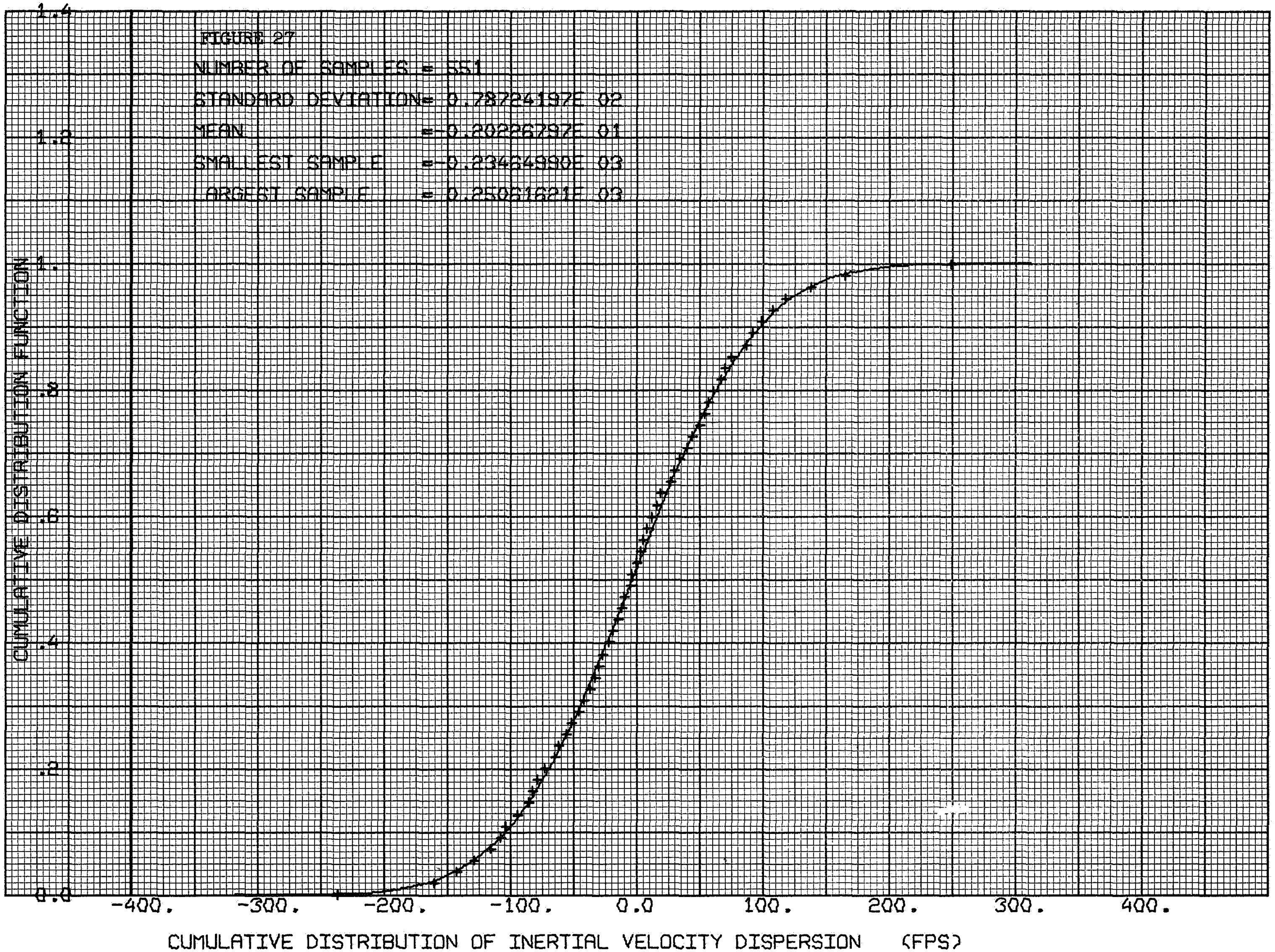


FIGURE 27
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.78724197E 02
MEAN = -0.20226797E 01
SMALLEST SAMPLE = -0.23464990E 03
LARGEST SAMPLE = 0.25061621E 03
CUMULATIVE DISTRIBUTION FUNCTION
1.4
1.2
1.
.8
.6
.4
.2
0.0
-400.
-300.
-200.
-100.
0.0
100.
200.
300.
400.
CUMULATIVE DISTRIBUTION OF INERTIAL VELOCITY DISPERSION (FPS)

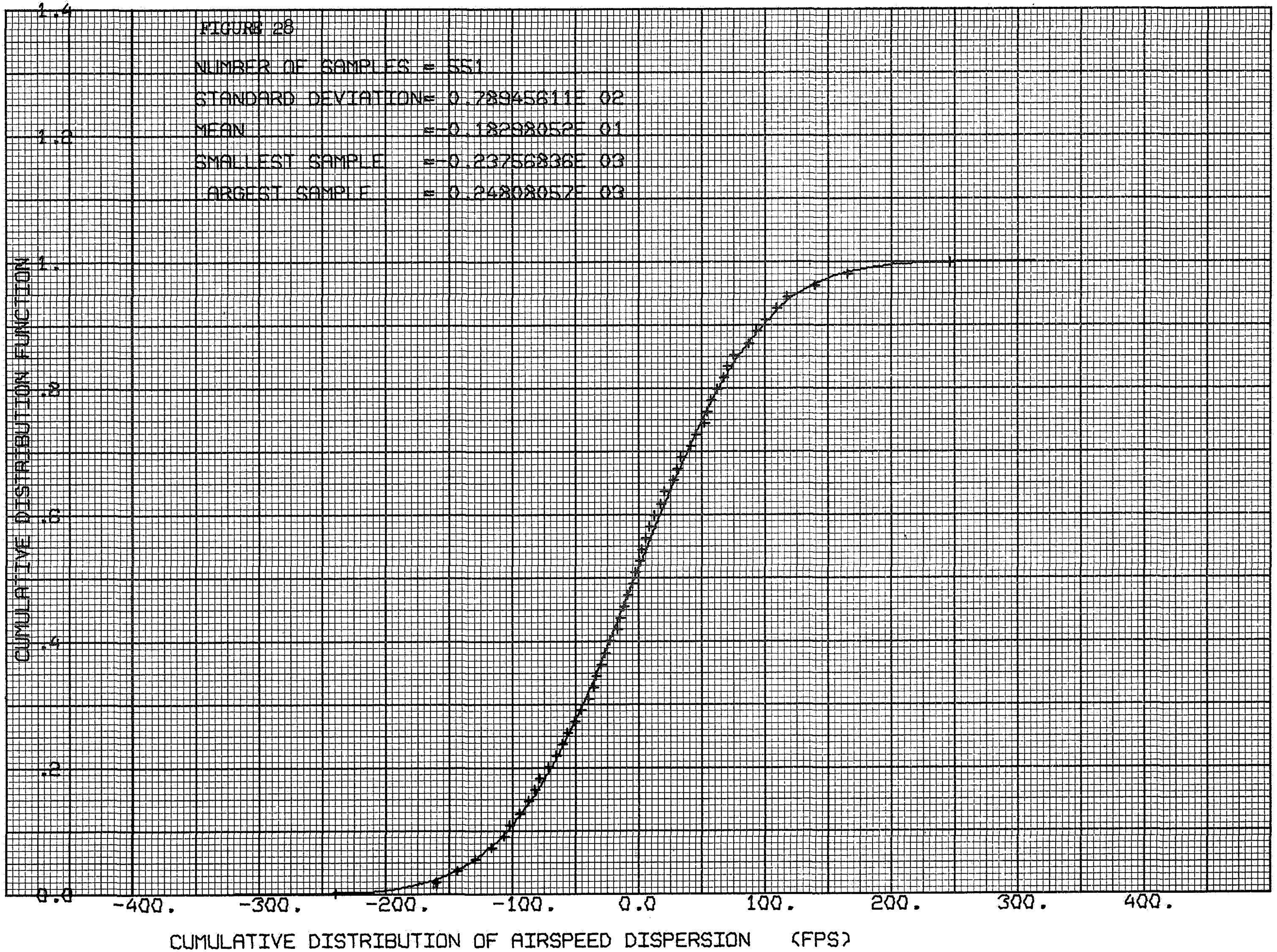


FIGURE 28
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.78945611E 02
MEAN =-0.18298052E 01
SMALLEST SAMPLE =-0.23756836E 03
ARGEST SAMPLE = 0.24808057E 03
1.4
1.2
1.
.8
.6
.4
.2
0.0
-400.
-300.
-200.
-100.
0.0
100.
200.
300.
400.
CUMULATIVE DISTRIBUTION FUNCTION
CUMULATIVE DISTRIBUTION OF AIRSPEED DISPERSION (FPS)

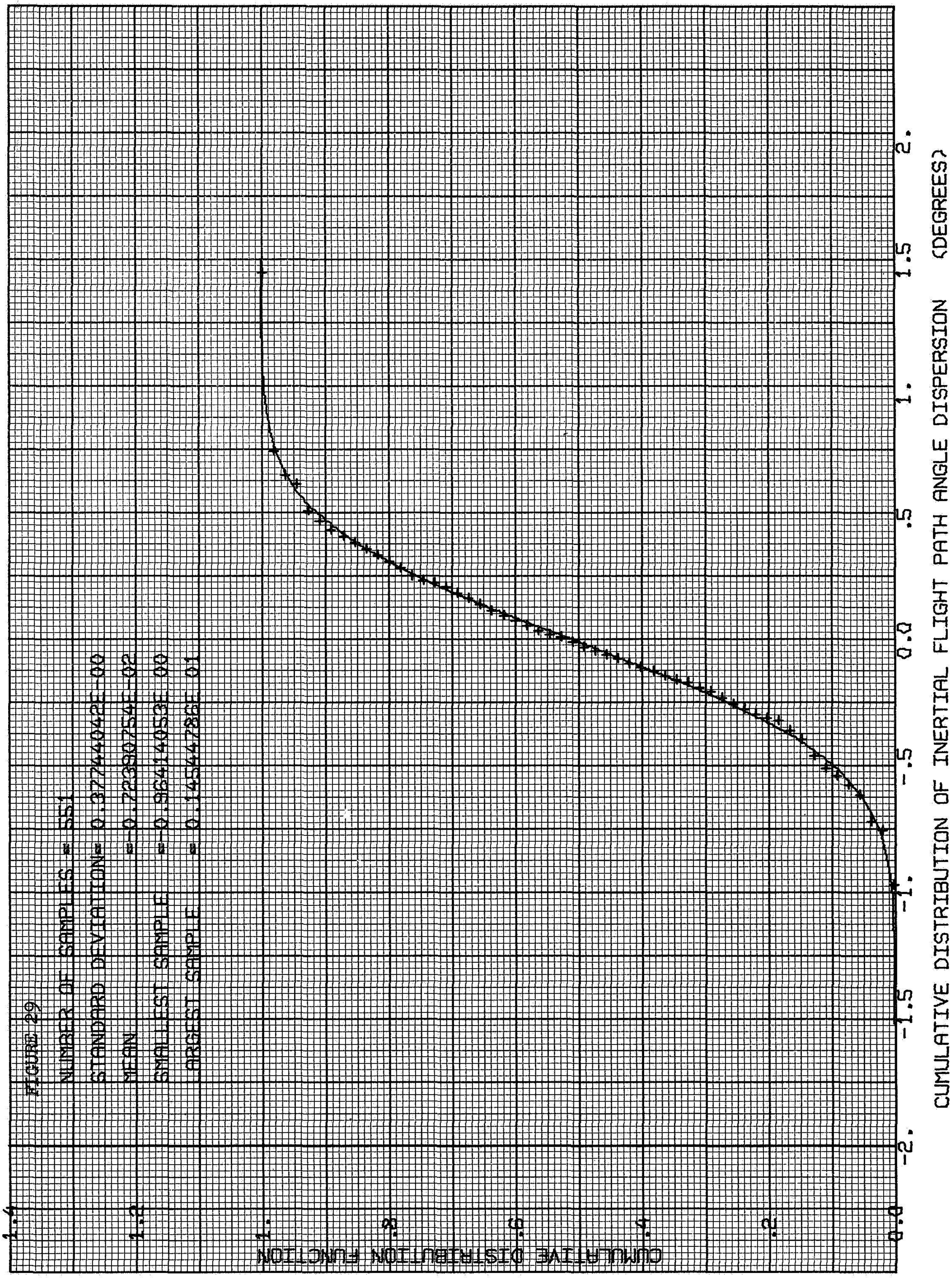
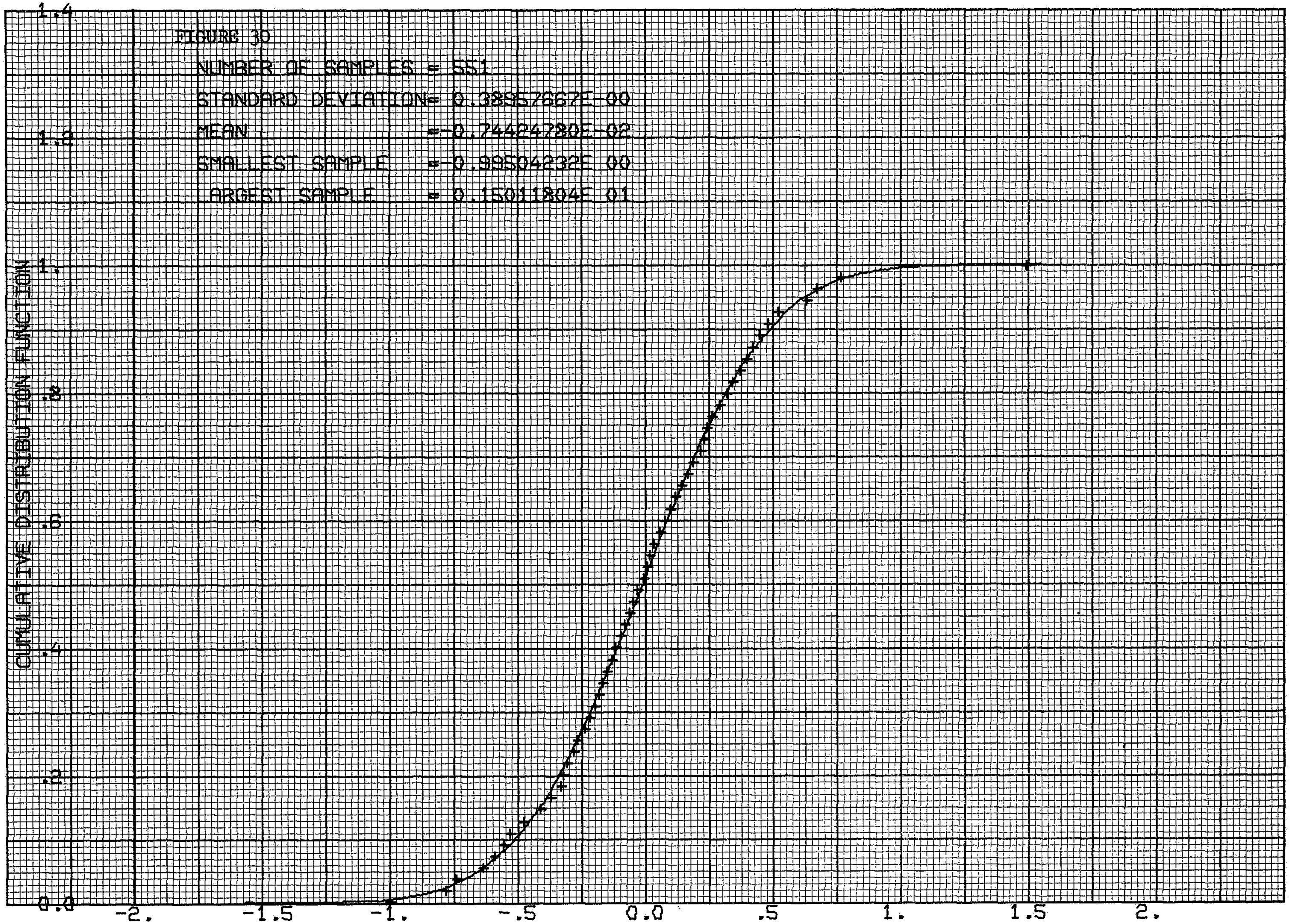


FIGURE 29
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.37744042E 00
MEAN =-0.72390754E-02
SMALLEST SAMPLE =-0.96414053E 00
ARGEST SAMPLE = 0.14544786E 01
CUMULATIVE DISTRIBUTION FUNCTION
0.0
.2
.4
.6
.8
1.
1.2
1.4
-2.
-1.5
-1.
-.5
0.0
.5
1.
1.5
2.
CUMULATIVE DISTRIBUTION OF INERTIAL FLIGHT PATH ANGLE DISPERSION (DEGREES)



CUMULATIVE DISTRIBUTION OF ATMOSPHERIC FLIGHT PATH ANGLE DISPERSION (DEGREES)

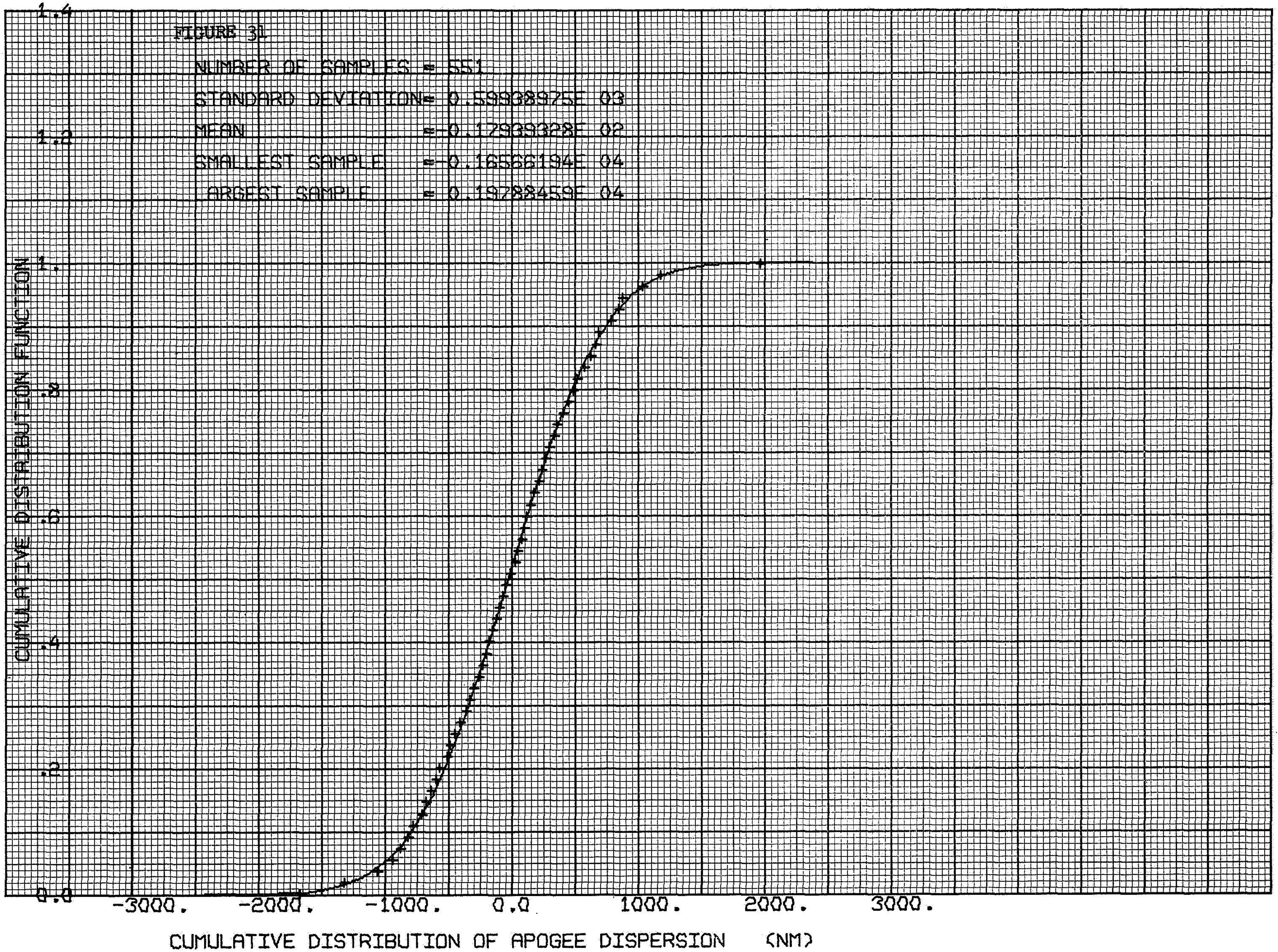


FIGURE 31
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.59938975E 03
MEAN = -0.17939328E 02
SMALLEST SAMPLE = -0.16566194E 04
LARGEST SAMPLE = 0.19788459E 04
CUMULATIVE DISTRIBUTION FUNCTION
1.4
1.2
1.
.8
.6
.4
.2
0.0
-3000.
-2000.
-1000.
0.0
1000.
2000.
3000.
CUMULATIVE DISTRIBUTION OF APOGEE DISPERSION (NM)

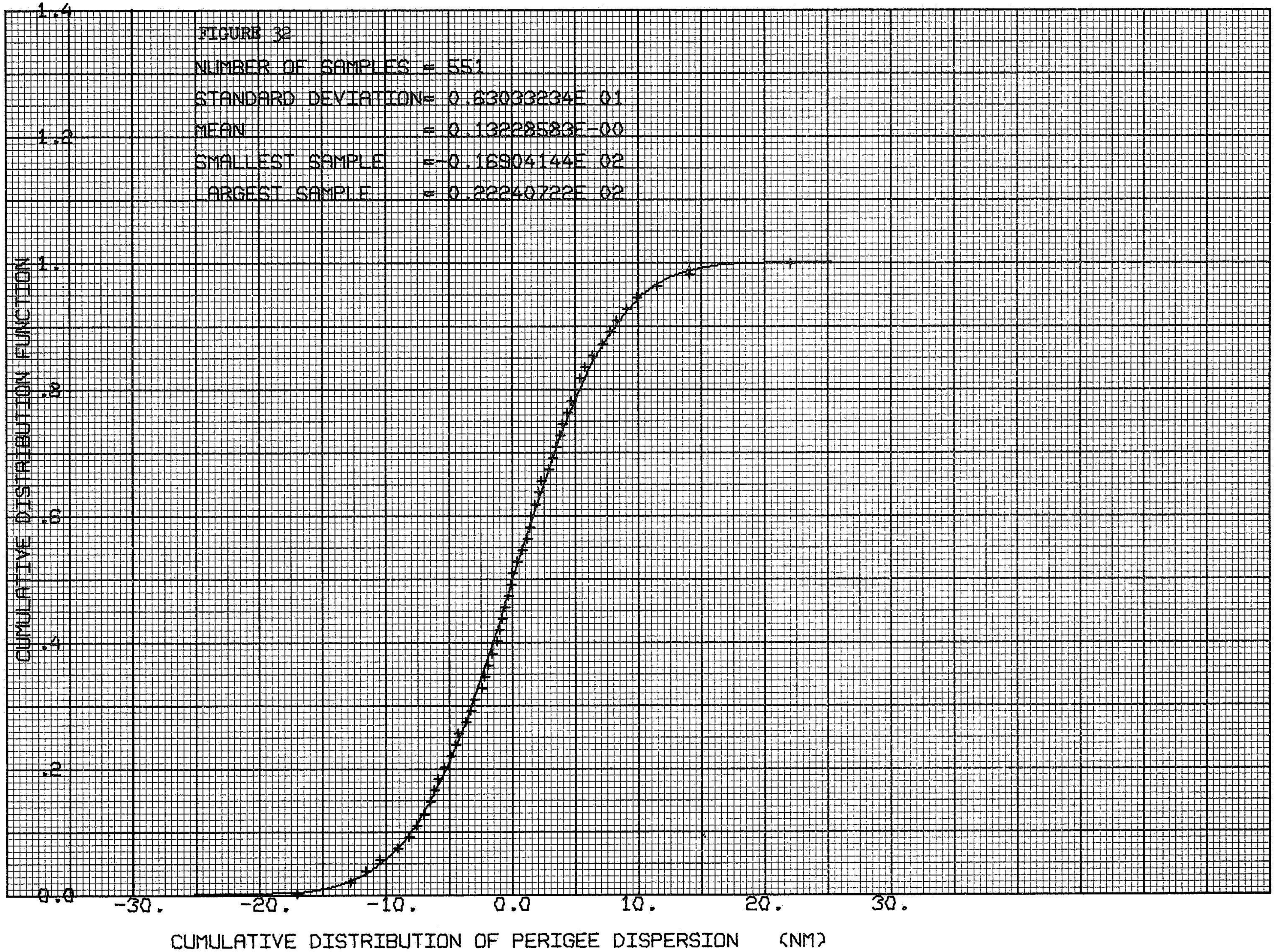


FIGURE 32
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.63033234E 01
MEAN = 0.13228583E-00
SMALLEST SAMPLE =-0.16804144E 02
LARGEST SAMPLE = 0.22240722E 02
CUMULATIVE DISTRIBUTION FUNCTION
1.4
1.2
1.
.8
.6
.4
.2
0.0
-30.
-20.
-10.
0.0
10.
20.
30.
CUMULATIVE DISTRIBUTION OF PERIGEE DISPERSION (NM)

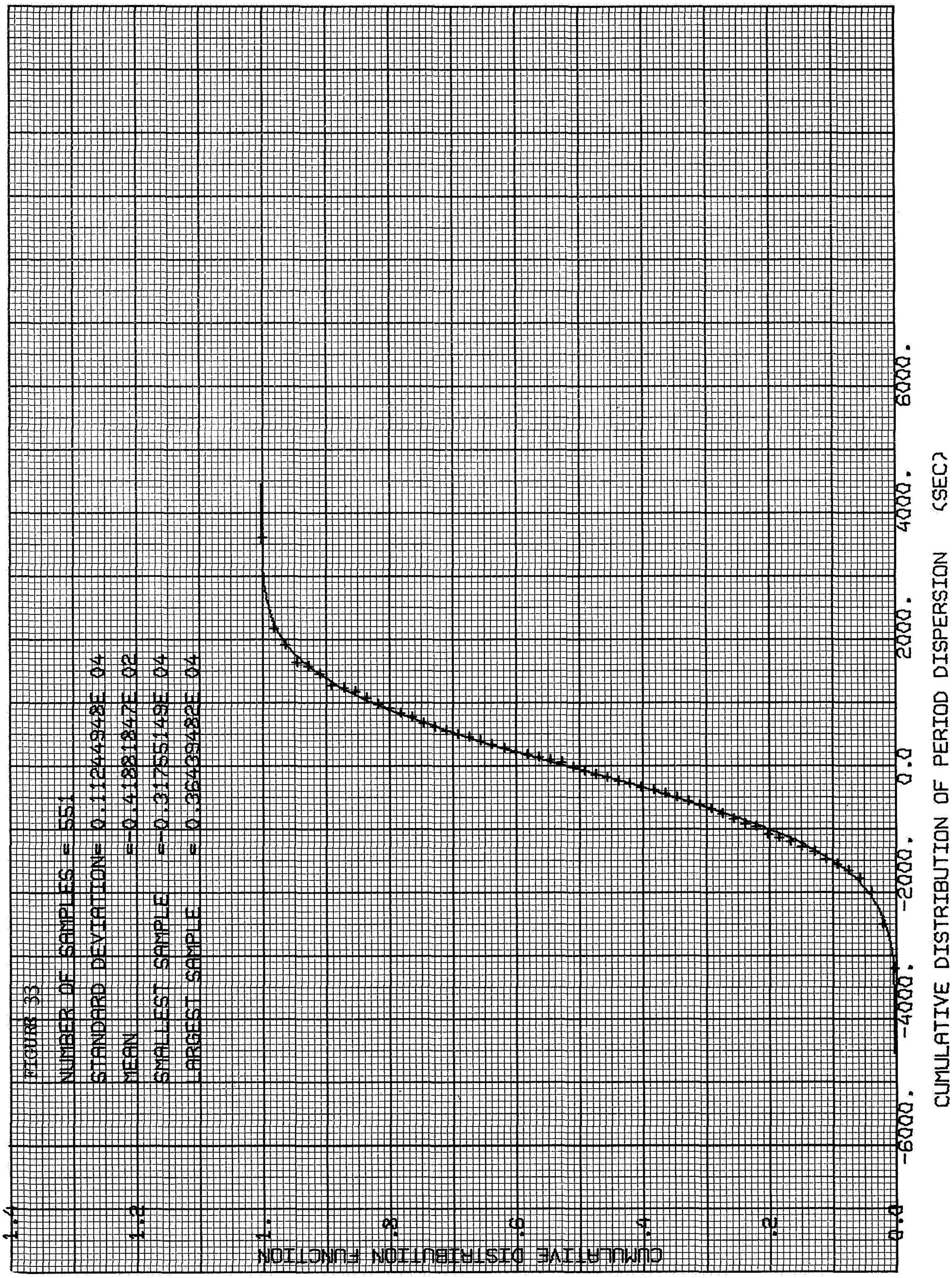


FIGURE 33
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.112449348E 04
MEAN =-0.418818847E 02
SMALLEST SAMPLE =-0.317551149E 04
LARGEST SAMPLE = 0.364394832E 04
CUMULATIVE DISTRIBUTION FUNCTION
0.0
.2
.4
.6
.8
1.
1.2
1.4
-6000.
-4000.
-2000.
0.0
2000.
4000.
6000.
CUMULATIVE DISTRIBUTION OF PERIOD DISPERSION (SEC)

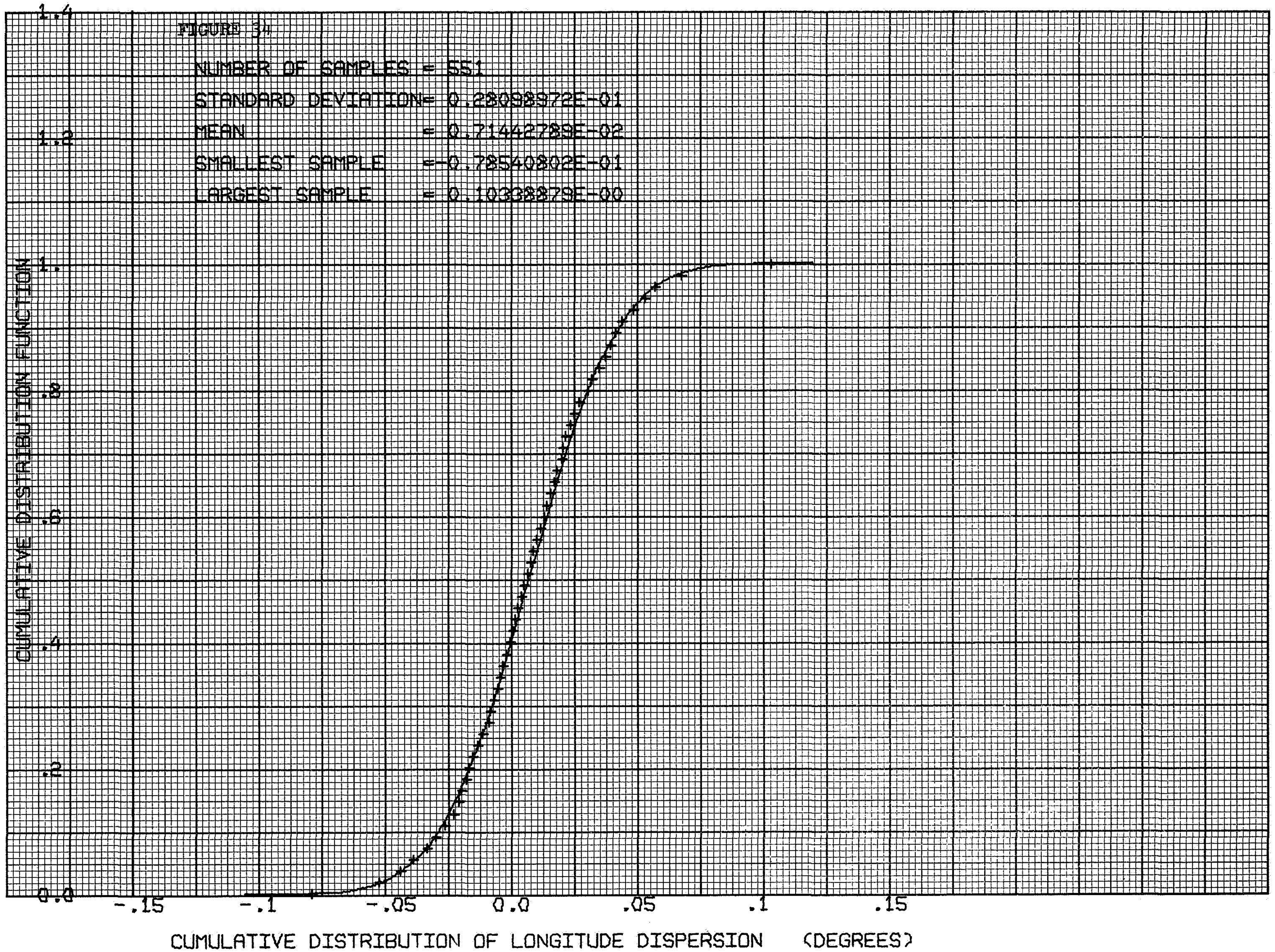


FIGURE 34
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.28098372E-01
MEAN = 0.71442789E-02
SMALLEST SAMPLE =-0.78540802E-01
LARGEST SAMPLE = 0.10338879E-00
CUMULATIVE DISTRIBUTION FUNCTION
0.0
.2
.4
.6
.8
1.
1.2
1.4
-.15
-.1
-.05
0.0
.05
.1
.15
CUMULATIVE DISTRIBUTION OF LONGITUDE DISPERSION (DEGREES)

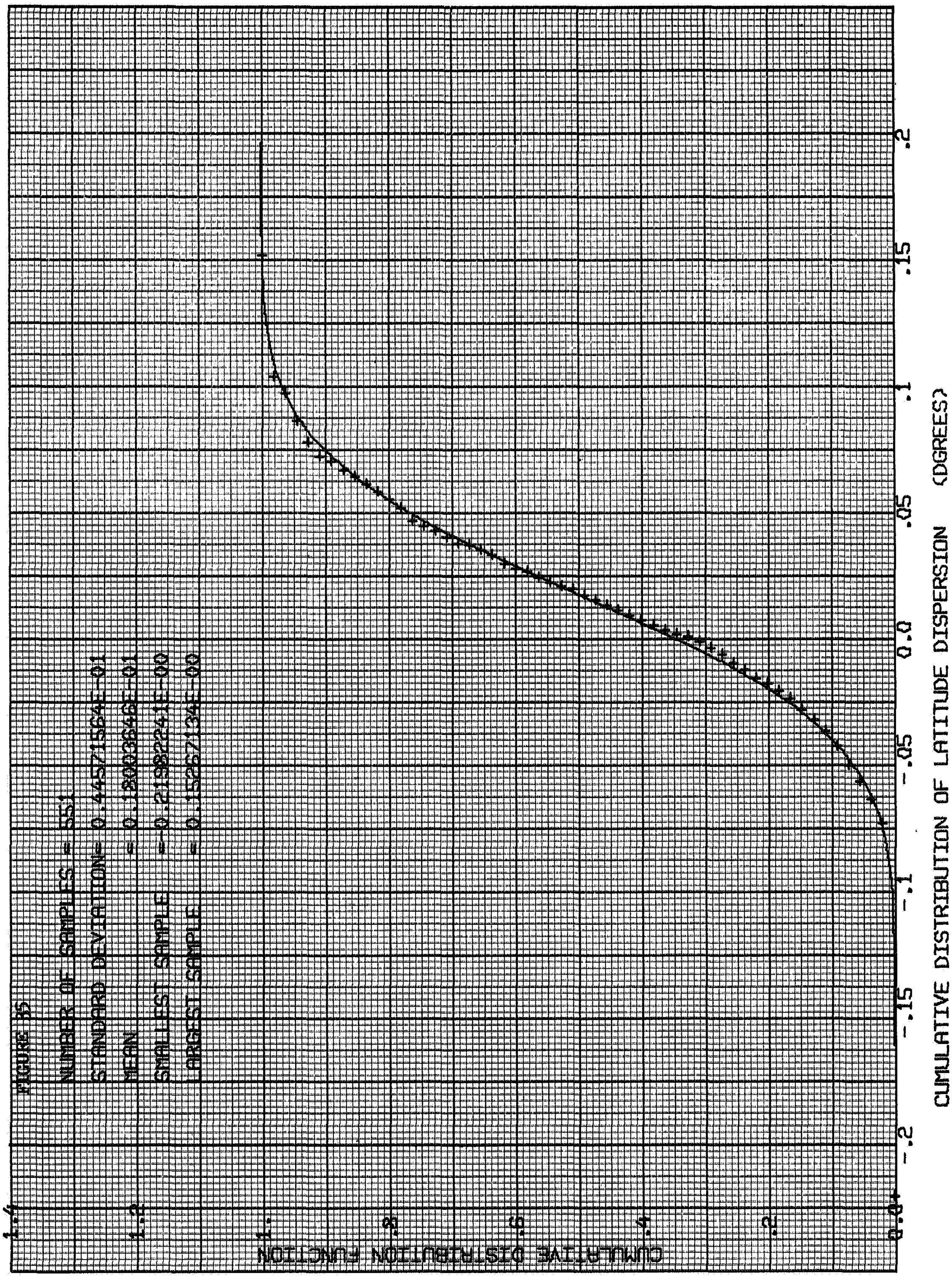


FIGURE 35
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.44571564E-01
MEAN = 0.18003646E-01
SMALLEST SAMPLE =-0.21982241E-00
LARGEST SAMPLE = 0.15267134E-00
CUMULATIVE DISTRIBUTION FUNCTION
1.4
1.2
1.
.8
.6
.4
.2
0.0
-.2
-.15
-.1
-.05
0.0
.05
.1
.15
.2
CUMULATIVE DISTRIBUTION OF LATITUDE DISPERSION (DGREES)

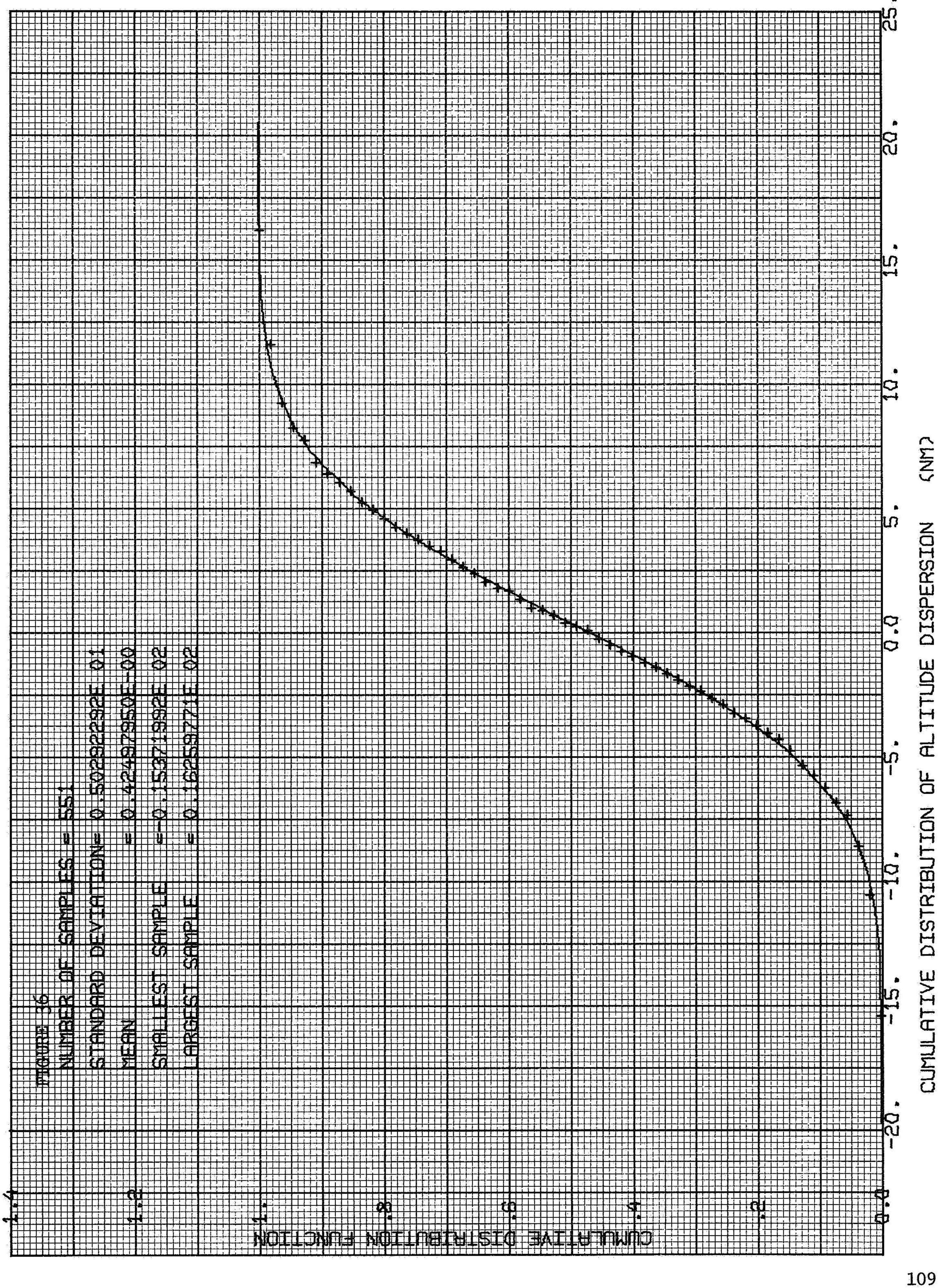


FIGURE 36
NUMBER OF SAMPLES = 551
STANDARD DEVIATION= 0.50292292E 01
MEAN = 0.42497950E-00
SMALLEST SAMPLE =-0.15371992E 02
LARGEST SAMPLE = 0.16259771E 02
CUMULATIVE DISTRIBUTION FUNCTION
CUMULATIVE DISTRIBUTION OF ALTITUDE DISPERSION (NM)
-20.
-15.
-10.
-5.
0.0
5.
10.
15.
20.
25.
0.0
.2
.4
.6
.8
1.
1.2
1.4

## CONCLUSIONS

The results of the analysis of two missions are presented in this report. These results indicate that, although the overall accuracy is not radically chang the effects of any individual error source is strongly dependent on the particula mission trajectory which is used.

Some general comments comparing the reentry mission, excape mission and the polar orbital mission which was analyzed in Phase I of this contract are in order The least sensitive trajectory is the excape mission since the large fifth stage burn reduces the effects of the lower stages, particularly in inclination, while burn itself is of such short duration that the trajectory errors are small.

The most sensitive is the reentry trajectory, partly due to the fact that the errors are propagated from burnout to reentry but also due to an increased fo stage sensitivity.

# REFERENCES

1. "Scout Error Analysis Phase I Final Report" by L.B. Cohen, etal., NASA CR 66596.